Railway Age

DAILY EDITION

FIRST HALF OF 1921—No. 10b CHICAGO—WEDNESDAY, MARCH 16, 1921—NEW YORK SIXTY-SIXTH YEAR

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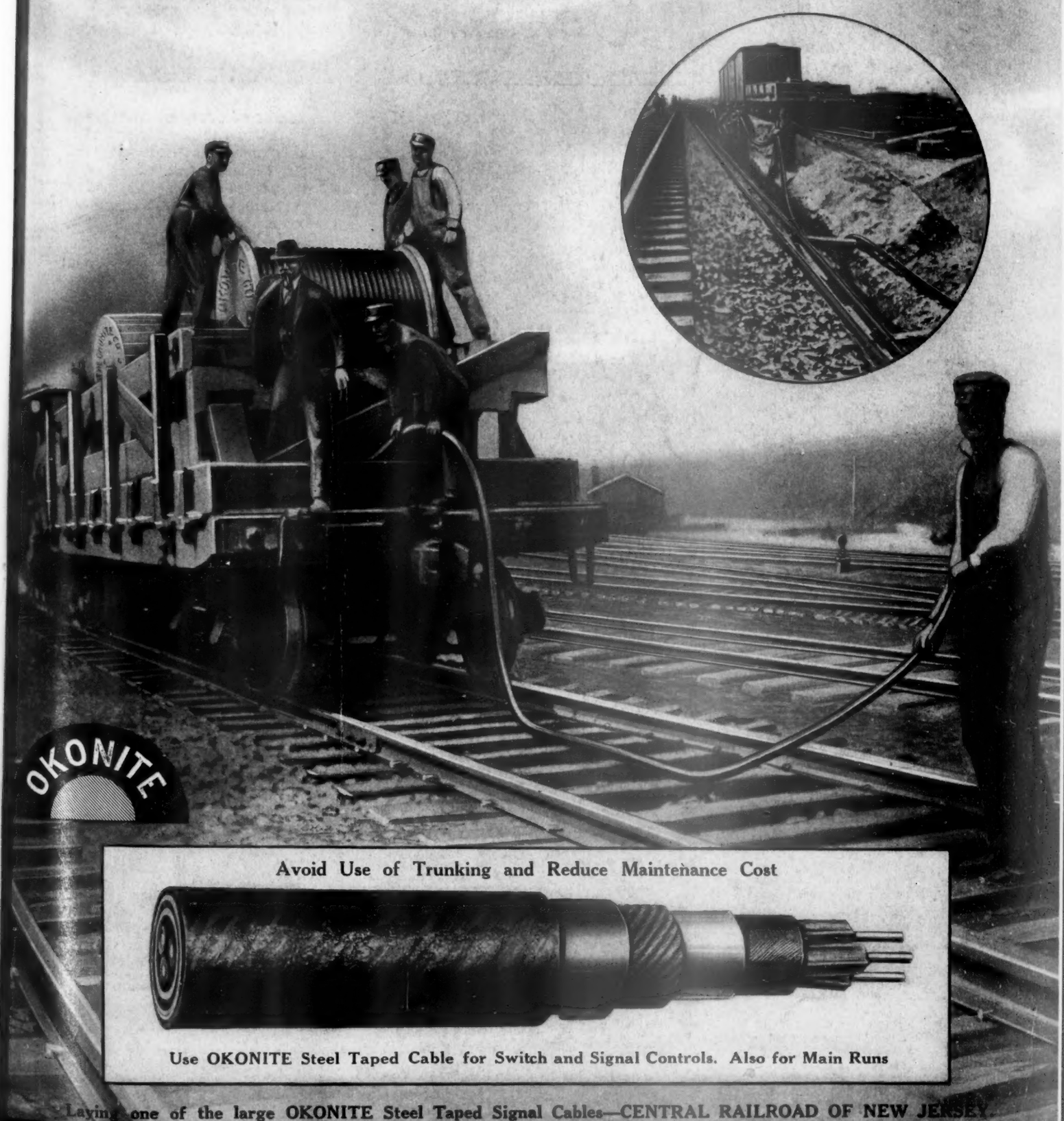
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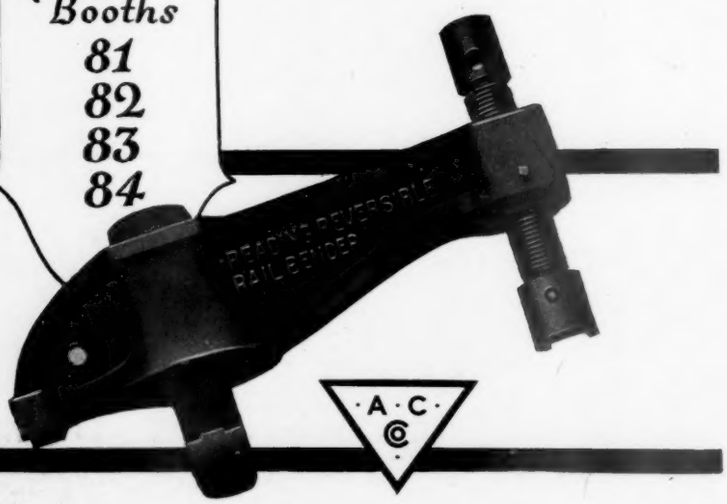

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Problem of Committee Personnel

The rapid growth of the Association in the last two years has introduced no small problem for the Committee on Personnel of Committees to provide for participation in the work by as large a proportion of the membership as possible. With only 23 regular committees and an association membership nearing 2,000, there are obviously not enough places on the committees as now organized to accommodate all who may wish to serve. Just how to overcome this difficulty is a problem for which various solutions have been suggested. One plan has been to increase the size of the committees and provide for greater independence of action by sub-committees. Another proposal is that made by President Safford in his address yesterday morning whereby members of the Association would be made "corresponding members" of certain committees, the idea being primarily to recruit the assistance of those members located in the more distant parts of the continent who are precluded from attendance at committee meetings. The idea of rotation in membership of committees is subject to the criticism that many of the members are peculiarly valuable to the committees on which they serve, because their long service has given them an intimate knowledge of the past work of the committees and the problems which they have previously encountered. With committee memberships at a definite premium, one thing is certain—there is no room for dead wood. Such a thing as vested rights to committee membership solely on the ground of seniority or long tenure of service is not to be thought of. The new members of the Association must have an opportunity to serve.

Make Them Hear What You Have to Say

Engineers are little concerned with orators or oratory. They seem to pride themselves on their ability to resist the wiles of honeyed speech or spirit-swaying declamations. Theirs is a vocation that deals in cold facts which call for quiet discussion around a conference table rather than eloquence from the rostrum. But is this not sometimes carried too far? Some A. R. E. A. members seem to forget that the annual convention is no longer a conference of a small group of engineers with kindred interests. Rather it approaches the proportions of a congress. In other words, the conversational tone of voice which suffices for speech before a small gathering simply will not "get by" before crowds the size of those attending the sessions in the Florentine room. Speak up!

The Track and the Locomotive

It is unfortunate that the line is so clearly drawn between the engineering and the motive power departments. The track and the bridges are so intimately related to locomotive and car design that they should all be considered in a large way as a single problem, instead of being almost entirely separated. Why, for instance, should the mechanical department consider the design of the locomotive almost purely from the standpoint of operation and cost of maintenance of the locomotive, when a larger expenditure for its first cost and facilities for maintenance will be offset many times by decreased damage to the track and bridges? Is the engineer officer advising the mechanical department of the vital necessity for reducing the dynamic augment to a minimum by showing clearly the extent of the damage which is now being done because of excessive dynamic augment?

New Committee Chairmen

One feature of this year's convention is to be noted in the large number of new committee chairmen—ten in all—only one of whom owes his appointment to the organization of a new committee, that of shops and locomotive terminals. This is a much greater change in committee heads than has been observed in any recent year. At the convention in 1920 only four regular committees had new chairmen; in 1919 there were six new chairmen; while of the six new chairmen in 1918 two headed newly formed committees. Whatever the motives responsible for the greater

change in committee chairmen this year it is believed that this is a trend in the right direction. Evidence of high grade leadership should be recognized and utilized to the fullest possible measure. At the same time a certain degree of rotation in chairmanship will serve to stimulate interest and effort on the part of the rank and file. This does not mean that it is at all desirable to place any arbitrary limits on the tenure of office of committee chairmen. The really important matter is to insure that each committee is under the direction of a leader who is qualified by experience, ability and temperament to accomplish the best results.

An Unusual Increase in Membership

The fact that the American Railway Engineering Association received over 500 new members during the past year, a larger number than in any previous year, is an indication of the inherent strength of the Association in the trying times through which we are now passing. While this large increase was attained as the result of a systematic campaign for members, the fact that the members were secured testifies strongly to the high esteem in which railway engineers hold the Association. The American Railway Engineering Association is unique among technical organizations in the way in which it conducts its work, and in the solidarity of its work. The result of its 23 years of activity are condensed in the Manual of Recommended Practice, aggregating approximately 1,000 pages. With the Association now comprising nearly 2,000 members, its influence is increasing accordingly.

Poor Ventilation in Meeting Room

Attention has been called repeatedly to the exceedingly poor ventilation in the convention room. This condition was exhibited strikingly yesterday, when every available chair was filled throughout almost the entire day. The air was so foul that a number of members were constrained to leave the room. The effect of this condition was also strikingly evidenced by the unusually limited discussion. Owing to the oppressive conditions in the room a number of the reports were not received with the interest that their contents justified. Thus the report of the Track Committee, which contained a number of conclusions which were the occasion of spirited discussion and controversy within the committee, were received without comment by the Association, considerably to the surprise of the members of the committee. The convention room has many admirable advantages, prominent among which is its lack of outside exposure to the noise of the city. However, this condition makes even more necessary the installation of adequate ventilation, for it is not possible to secure relief by opening windows.

Record Convention Attendance

THE ATTENDANCE AT THE CONVENTION of the American Railway Engineering Association yesterday was the largest in history and the discussion of committee reports was characterized by great earnestness. These facts indicate that the engineering and maintenance officers of the railways realize that present conditions demand the most profound study and the hardest kind of work if efficiency and economy of operation are ever to be restored. The present is an opportune time to emphasize the fact that the greatest efficiency and economy in operation cannot be obtained by the adoption of temporary drastic expedients to meet emergencies, but only by thorough study and planning and by intensive efforts over a period of long years to carry out the plans made. The largest economies ever effected have been the result of vast capital expenditures made to reduce grades, strengthen tracks, lengthen passing tracks and enlarge yards to enable the railways to operate more powerful locomotives and larger trains and thus handle traffic in larger units and at lower labor costs per ton and per passenger carried. There is a natural tendency in periods of stress such as the present to cease working on plans which will require millions of investment and years of time to carry out and concentrate attention and effort on meeting immediate conditions, but in the long run the best results are obtained by steadily continuing the effort to carry out well-conceived plans, and to subordinate their execution to the use of immediate expedients only to such an extent as is absolutely necessary. A very large and important part of the scientific planning for future railway development and future increases in efficiency is entrusted to the higher engineering officers, and it is gratifying to find that even in an acute period such as the present they are disposed to take active part in the study and discussion of the fundamental problems. One of the main causes of the troubles of the railways today is that since this country entered the war in 1917 the making and carrying out of far-reaching plans of improvement has been seriously interfered with. If important increases in the efficiency and economy of operation are to be resumed, the making and carrying out of far-reaching plans of improvement must be resumed, and it is essential to the making of such plans that all the problems involved shall first be carefully studied and thoroughly discussed.

Today's Program

The program for today's sessions of the American Railway Engineering Association is as follows:

Committee No.	IX.	Signs, Fences and Crossings	Bulletin 232
Committee No.	III.	Ties	Bulletin 232
Committee No.	XV.	Iron and Steel Structures	Bulletin 232
Committee No.	XIII.	Water Service	Bulletin 232
Committee No.	XXII.	Economics of Railway Labor	Bulletin 231
Committee No.	XXI.	Economics of Railway Operation	Bulletin 234
Committee No.	XVI.	Economics of Railway Location	Bulletin 233
Committee No.	XXIII.	Shops and Locomotive Terminals	Bulletin 233
Committee No.	VI.	Buildings	Bulletin 235

Annual dinner at 6:30 p. m.

Changes in Engineering Organization on the New York Central Lines West

Newspaper reports concerning reductions in the official personnel of the New York Central have excited considerable interest among those attending the convention, but unfortunately these items were so incomplete as to give little real information concerning the actual changes. Inquiry has shown that these changes as regards the New York Central Lines West, in so far as they affect the higher officers of the engineering department are not nearly so drastic as might have been assumed from the newspaper accounts. These changes were as follows: R. O. Rote, assistant chief engineer, will take over the duties of H. B. Reinsagen, engineer maintenance of way, whose position has been abolished. Mr. Reinsagen has been

appointed principal assistant engineer, succeeding A. M. Currier, and Mr. Currier has been made engineer grade separation, succeeding C. F. Mayer, who has been assigned to other duties.

Car Loadings Increase

WASHINGTON, D. C., March 15, 1921.

Evidences of increased traffic on the railways are afforded by the weekly car loading statement of the Car Service Division of the Interstate Commerce Commission, showing that the number of cars loaded with revenue freight for the week ending March 5 was 712,822, an increase of 54,000 as compared with the preceding week. This is the first week this year to show any considerable increase in car loading and the loadings for this week are larger than for the corresponding week during the business depression of 1919. The loading of grain and grain products, of merchandise and of miscellaneous freight was greater than for any previous week this year.

Purdue Luncheon Today

Purdue University men will lunch today at the University Club, corner Michigan and Monroe, at 12:45 p. m. All Purdue men are urged to report at the University Club at that time.

More Winslow Bill Payments

WASHINGTON, D. C., March 15, 1921.

The Interstate Commerce Commission has issued a certificate for partial payments on account of the guarantee to the Trans-Mississippi Terminal Railroad for $110,000, the Chicago, Rock Island & Pacific for $6,000,000, the Chicago Great Western for $500,000, the Chicago, Indianapolis & Louisville $400,000, the Chicago & Northwestern $12,000,000, and Gulf, Mobile & Northern $50,000. The commission has also issued a certificate in final settlement for its deficit during federal control to the Western Allegheny amounting to $114,000. The returns to the Interstate Commerce Commission by 43 Class I railroads show a net operating deficit of $3,120,000.

Correction of an Error

In the story in the Daily of yesterday entitled "The Railroad Labor Board Subpoenas Railroad Officers" the statement was made that a subpoena was issued for W. T. Tyler, vice-president of the Northern Pacific. This was a mistake. The subpoena was issued for Thomas DeWitt Cuyler, chairman of the Association of Railway Executives. The other persons subpoenaed were W. W. Atterbury, vice-president of the Pennsylvania Railroad; C. R. Gray, president of the Union Pacific, and Robert S. Binkerd, assistant to the chairman of the Association of Railway Executives.

B. & L. E. Supervisors at Coliseum

The Bessemer & Lake Erie arranged for all of its track supervisors to spend Monday at the Coliseum. The party left Pittsburgh Sunday morning, traveling by daylight to Chicago over the B. & O. and studying the standards of track maintenance of that road.

The Bridge and Building Executive Committee Meeting

The Executive Committee of the American Railway Bridge and Building Association and interested members will meet in the Congress hotel at 4:30 this afternoon to plan for the next convention, which will be held in New York in October.

The A. W. P. A. Dinner

Over 50 members and friends of the American Wood Preservers' Association gathered at dinner at the Hotel Sherman last evening to discuss problems of interest to the wood preserving industry and to witness the presentation of the moving picture films which were taken on the recent trip of the members of that association to the Pacific coast to attend the convention at San Francisco in January.

New Division Engineer on S. A. L.

W. D. Simpson has been appointed division engineer of the Florida division of the Seaboard Air Line at Tampa, Fla., succeeding B. Land, Jr., resigned.

The Annual Dinner

W. A. Wallace, chairman of the sub-committee of the Arrangements Committee in charge of the annual dinner of the American Railway Engineering Association, urges those members planning to attend the dinner this evening to get their tickets promptly, for the reason that the Congress hotel management must be notified at noon. Tickets will be on sale in the lobby outside the convention hall. This dinner will be held in the Gold room at 6:30 p. m. The speakers will include John F. Wallace, consulting engineer, New York City, and formerly chief engineer and general manager of the Illinois Central and chief engineer of the Panama Canal; Dr. David Kinley, president of the University of Illinois, and the Honorable William Renwick Riddell, Justice of the Supreme Court of Ontario, Can.

Requisites of Train Control

The Joint Committee on Automatic Train Control has issued its circular No. 2 on the functions and requisites of train control systems so far as these have been developed to date.

Signal Business Picking Up

The Missouri Pacific has reopened bids for the necessary material to construct a mechanical interlocking plant where its line crosses the St. Louis-San Francisco at Aurora, Mo. Bids were originally asked for a 40-lever frame mechanical machine at this point, but due to track changes made on the Frisco it was necessary to reopen the bid. Power signals will be used on the Frisco in connection with its automatic signal system.

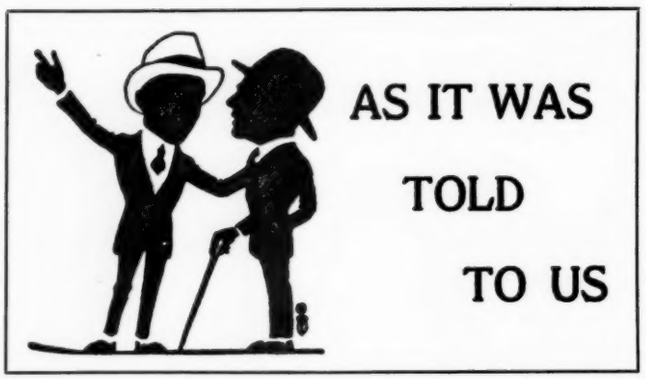
Burlington Officers Meet

The Permanent Way committee of the Chicago, Burlington & Quincy and the Roadmasters' committee of the same railroad held meetings at the general offices of the Burlington in the city yesterday and Monday to discuss problems of the maintenance of way department.

Senate Fails to Confirm Appointment of J. J. Esch

WASHINGTON, D. C., March 15, 1921.

The Senate failed yesterday to confirm the appointment of J. J. Esch as a member of the Interstate Commerce Commission because of the insistence of Senator LaFollette on his right to file a minority report to the action of the Committee on Interstate Commerce Commission, recommending the confirmation. This action on the part of Senator LaFollette will delay the confirmation of Mr. Esch until the extra session of Congress which is called for April 11. The appointment of M. W. Potter as a member of the commission was confirmed on Saturday, as announced in yesterday morning's daily.



One of the familiar faces which is missing from the convention this year is that of A. R. Fugina, signal engineer of the Louisville & Nashville, who is detained at home recovering from a severe illness.

* * *

S. A. Jordan, engineer maintenance of way of the Baltimore & Ohio, Lines West, finds that there are some bright spots in railroading even when things look dullest for because of that he has been able to attend the convention for the first time in two or three years.

* * *

Among the prominent railway supply men who are attending the exhibit of the National Railway Appliances Association for the first time is W. B. Lashar, president of the American Chain Company, Bridgeport, Conn. Mr. Lashar came to Chicago purposely to attend this exhibit.

* * *

The fact that Cuba possesses attractions as a winter resort for railway as well as railway supply men is shown by the fact that W. H. Hoyt, chief engineer of the Duluth, Missabe & Northern, is stopping over at the convention on his way home from a six weeks' trip to that island and Florida.

* * *

Herbert Deeming, formerly of the firm of Deeming and Endsley, who has been in the shipping business in New York City for over a year, has returned to Chicago and the railway supply business. Seen at the Coliseum yesterday, he expressed considerable pleasure at his return to the railway game.

* * *

The friends of M. J. Trees, vice-president of the Chicago Bridge & Iron Works, have watched with considerable envy the frequent business trips which Mr. Trees has made to Cuba during the past year. He has found it necessary to make no less than four such trips during 1920 and one trip since January 1.

* * *

Ralph T. Hatch, for the past 14 years connected with the National Malleable Castings Company, will join the forces of the American Chain Company when he will become general manager sales of the Reading Steel Casting Company, a subsidiary of the American Chain Company, with headquarters at Reading, Pa.

* * *

Edwin Gagel, chief engineer of the New York, New Haven & Hartford, was an interested attendant at the convention yesterday. This is the first time Mr. Gagel has attended a convention. Mr. Gagel is a new member of the Association, having joined during the past year. He is one of about 15 officers of the New Haven Railroad who are present.

* * *

H. T. Porter, chief engineer of the Bessemer & Lake Erie and an active worker on the Track Committee, was present at the convention yesterday and participated in the presentation of the report of that committee. It was necessary for Mr. Porter to leave last evening for Washington to participate in negotiations incident to the settlement of claims rising out of federal control.

* * *

Colonel H. S. Crocker, acting secretary of the American Society of Civil Engineers, was an interested visitor at the convention yesterday morning. Colonel Crocker has been serving in this position for over a year pending the selection of a permanent secretary. He has recently asked to be relieved of these duties in order that he may resume his private practice. Colonel Crocker stopped only for the day while enroute to Denver to reopen his office.

* * *

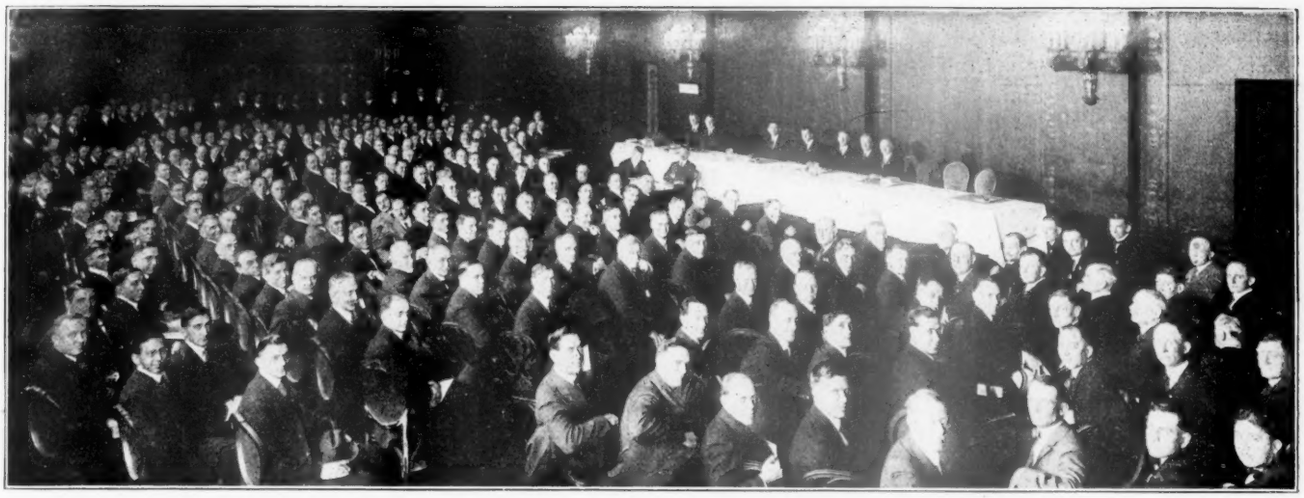
E. B. Katte, chief engineer electric traction, New York Central, and a member of the Board of Directors of the A. R. E. A., is also chairman of the professional section on Railroads of the American Society of Mechanical Engineers. The spring meeting of the A. S. M. E. will be held in Chicago, May 23-26, and the Railway Section is arranging for a revision of the problems connected with the design and maintenance of large freight locomotives.

* * *

E. R. Lewis, editor of the Maintenance of Way Cyclopedia, and now office engineer of the Michigan Central, at Detroit, Mich., was a first day attendant at the convention. Mr. Lewis, on the completion of the cyclopedia, left for a trip to Panama and other points south, but we understand that he spent his entire vacation in Cuba, stating for his reason that he sprained his ankle and could go no further. It is not at all surprising that an American citizen would let his foot slip when in Cuba.

* * *

F. A. Poor, president of the P. & M. Company, returned on February 12 from a month's trip to England. He is a director in the P. & M. Company of England, Ltd., which handles the products of this company abroad. Mr. Poor reported that railway conditions abroad so far as he had opportunity to observe them are very bad. The railways of India, Australia and South America buy a large part of their equipment and supplies in England. The railway conditions in these countries, as indicated by the inquiries for equipment and supplies in London, are beginning to improve but still are very unsatisfactory. Sentiment abroad is that business conditions will not get good until the whole general financial condition has been cleared up and that it cannot be cleared up until a definite determination of reparation to be paid by Germany and the other central allies has been reached. Mr. Poor found that the competition of European manufacturers for railway equipment and supply business is becoming more energetic. This is especially true of the manufacturers of Germany and Belgium. The low rate of exchange and the prevailing low wages of labor, especially in Germany, are enabling Belgium and German manufacturers to produce iron and steel articles cheaper than they can be produced in the United States and other countries. He found that the prevailing wage in the iron and steel industry in Germany is about 300 marks a week which at the present rate of exchange is equivalent to about $6 a week in American money. British manufacturers are not getting on their feet as rapidly as those of Germany because the iron and steel industry in Great Britain is so highly unionized that it has been impossible thus far for the manufacturers to get their costs down to a basis where they can meet the competition of the Germans.



The A. R. E. A. in Session Tuesday Afternoon

American Railway Engineering Association Proceedings

Record Crowd at the Opening Session in the Florentine Room Yesterday Morning

ANY DOUBT AS TO the success of the twenty-second annual convention of the A. R. E. A. was definitely dispelled by the capacity of the crowd which was present at the opening session yesterday morning to hear the address of President H. R. Safford, assistant to the president of the Chicago, Burlington & Quincy. As the minutes of last year's meeting have been printed and distributed, their reading was dispensed with and the convention passed immediately to the president's address. Following this the reports of the secretary and treasurer were presented, after which the Association began the consideration of the reports of committees.

Reports were presented by the committees on Signals and Interlocking, Ballast, Electricity, Stresses in Railroad Track, Track, and Rail. Reports on Standardization and Uniform General Contract Forms come up today.

Address of President Safford

THIS ANNUAL MEETING MARKS the close of the twenty-second year of the life of the American Railway Engineering Association—practically a generation as human life is measured. In some ways, it would seem that we have just passed through a period which will mark a very definite generation in the history of railroads. This thought is suggested when we recall that at the end of the Association's twenty-first year we find the railroad industry, of which we are a part, at the threshold of a new era.

Many things point to this belief. The new Transportation act expresses a desire on the part of the public for private control with protective regulation, with expressed support of efficient and honest management and an earnest desire to restore confidence in the enterprise and credit to the structure.

The termination of federal control and the restoration of the properties to their owners coincident with the passage of the new Transportation Act seem to mark the close of a period when there was a noticeable and increasing tendency toward excessive and burdensome regulation, an increasing failure upon the part of the public fully to understand and appreciate the rail transportation structure and especially a failure to realize the interdependence and joint responsibility resting upon both the railroad and the user to create, support and maintain what the public most desires, namely, good transportation. A great change and I believe for the better has taken place. New powers and responsibilities are assumed by lawfully created public bodies. A different attitude is observed on the part of the shipper and the traveller and new conditions also surround the details of operation affecting theories of development and expansion of existing properties and the promotion of new projects, which are vastly different from 21 years ago.

This Association in devoting its entire attention to railway construction, operation and maintenance will find its efforts and results measured by the same standards applied to the various phases of railway service and we must feel the same sense of responsibility in trying to perfect the studies of the service which are entrusted to us that is felt by the executive and financial heads if we are to do our part in making the business successful and of permanent existence as a private enterprise. Probably no industry felt as severely the impact and the continued stresses of the war. It seemed sometimes as if the structure would not survive the eccentric and unexpected strains for which it was not designed, but it has done so, and from the test will be developed new formulæ giving truer results in future study and the structure should be much more scientifically designed than ever before.

We are now passing through the severe and trying period of readjustment from the war strain and greater therefore is the need for intensive study of economic

problems and renewed efforts to direct controlling influences to a stabilization of the situation so that the industry may thrive and prosper as intended by the new legislation.

Membership Increases

A review of our own activities as an association for the past year seems quite in order and I turn first to the matter of membership. It has always been the policy to place a high premium upon quality of membership with the very definite goal of securing the highest degree of efficiency and the most finished product in the Manual. On the other hand the restrictions have not been pronounced in so far as departmental representation is concerned and encouragement has always been given to applications from officers in the transportation as well as from the construction and maintenance departments; this because the Association has endeavored to co-ordinate transportation, construction and maintenance of way in matters which jointly interested these several branches. I believe that this idea has done much to keep interest in the Association and accounts for the par excellence of its work.

The encouragement which has always been given by railway executives has made it attractive for members to join and work. We have probably inclined in the past too much toward the policy of allowing the individual to seek us and have made too little effort to interest the outsiders, and while it is possible always to go too far in adding members for numbers only, on the other hand we must not sit idly by and fail to keep apace with the natural growth in general railway organization and should not hesitate to show fully and aggressively to all interested in the business the benefit to come from membership.

There are a great many officers who are not, but should be, members and if the practical advantages are indicated to them they might become members. We have always disliked the idea of a spectacular and exciting campaign for membership, but last year a dignified but earnest effort was made to interest men, with the result that from January 27, 1920, to March 1, 1921, there were 514 additions to the membership.

There were also deaths of some members which are recorded with deep regret, men who gave a great deal of earnest effort to the work and whose counsel is missed:

O. W. Albee	J. W. Wilkinson
Sir James B. Ball	Paul L. Wolfel
W. A. Cattell	R. C. Sattley
P. S. Hildreth	E. S. Draper
A. S. Markley	W. H. Moore
John G. Shillinger	A. T. Tomlinson
T. H. Hickey	L. J. Putnam
William Travers	G. W. Vaughan
T. H. Sears	E. V. Smith

Financial

The report of the secretary and treasurer shows a very satisfactory situation for the year and reflects great credit upon these officers as well as the Board Committee in charge of Finance. In the face of continual increase in costs of printing especially, and perhaps to a less extent in other things, we have been able to carry on without any increase in dues and without drawing upon our reserves. It is hoped this may continue, although until prices become more nearly normal, it may not be expected that our assets will increase as rapidly as in past years.

It has been the policy not to try to build up a large investment, but to invest the surplus in such a manner as to be in position to meet any emergency which may require temporary assistance in meeting unusual demands. Our invested funds are assisting in meeting annual expenses from interest bearing securities. The time may come when some use may be made of these funds in their application to research work and this possibility should be kept in mind, as I believe that should be the ultimate desire.

It is proper here to allude to the several kinds of assistance from outside agencies in promoting research work. The splendid results which have come from these special lines of study speak for themselves and this assistance is appreciated. I refer particularly to the work of the Committee on Stresses in Track and the Committee on Rail. I would especially commend to the members the published result of the last two years from these committees. It is not a waste of time to read them and give this committee all the support possible by way of suggestion.

Committee Personnel

The increasing membership offers new problems in arranging the personnel of committees to obtain broad representation and effective work. It obviously is impracticable to put all the members on committees all the time, but the desirable thing is to encourage all members to have some committee service. There are always differences in the degree of support which members will give to committee work and committees should always be composed of good workers.

During the past year the Committee of the Board on Personnel has made extraordinary efforts to work out the problem and has made progress in getting changes in personnel, but they need assistance from you as individuals both as to offers of service and suggestion of preferential service. My own idea is that members should desire to obtain a varied committee service and occasionaly shift from committee to committee to broaden their experience and to prevent autocracy in committee policy. A varied committee service is a splendid opportunity for the young man to grow in his profession beyond the confines or limited activities of his own particular branch of the service.

Committees can be too large and fail to function well on that account, but they can be too small as well, and can be composed of too limited a representation geographically and can be so greatly spread as to fail to obtain good attendance. Committee organization is a very important matter, probably the most important of all, because that is the means by which our work is done.

I would urgently recommend the establishment of joint conference between the Committee of the Board on Personnel and the various committee chairmen, both at the beginning and end of the year, to perfect the committee organization. This seems to be the most effective way of developing the fitness of members for committee service and to co-ordinate the work of the several committees whose work is related.

To afford opportunities to a larger number of members to have a share in committee work, it has been proposed to establish what might be termed "Corresponding Members" of committees. Many members of the Association are so situated geographically, or for other reasons, as to make attendance at committee meetings impracticable. Such members could nevertheless contribute materially to the value of committee work by correspondence. The Board Committee on Personnel is giving the suggestion further thought.

Committee Service

Here is an important phase of our work, two features of which I would specially mention: (1) Co-ordinat-

ing the work of different committees whose subjects are inter-related, and (2) character of Reports.

The first seems to become increasingly important as the subjects expand and one of the real difficult duties of the Board Committee on Outline of Work is to assign the subjects requiring co-ordination.

I believe one of the most effective means to assign this work is through a joint conference of the committee chairmen and the Board Committee on Outline of Work. This would systematize the work and obtain the benefits from conference in expression of views and will result in a clearer understanding as to what is wanted, and minimizes duplication of effort.

The matter of character of reports is one which has caused concern to the Board on account of the rapidly increasing size of Committee Reports due to the natural expansion of the subjects and the increasing costs of reproduction. The thought I try to convey is to consider the material collected during the research period and see if there cannot be a curtailment of volume without sacrificing the value of the report.

I believe too we have come to the point of doing more experimental work by sub-committee organization and less dependence be placed upon personal viewpoint in majority expression without actual supporting data from organized demonstration or test. In this connection I want to suggest that we avoid too great a speed in trying to conclude research for the purpose of definite recommendation sometimes at a sacrifice of thoroughness. This is not said in criticism of past practice but to call attention to the increasing complication of the many questions before committee.

H. R. Safford
President

University Co-operation

During the year the Association was asked to send to the University of Illinois and Purdue University committees to look over their facilities and methods with the ultimate idea that we might give such assistance as we could in the further development of their courses. In accordance with that request such committees visited the universities and reported favorably upon their work and methods.

These invitations permit the opportunity I have anticipated for some time to offer the recommendation that the Association should make systematic effort to establish and extend contact with technical schools. This is desirable not only for the purposes which have brought about the relations with those with whom we have had co-operation in committee work, such as impact tests and stresses in track, but for the larger matters of university work in which we are interested as employers of engineers.

Offer of Assistance to the Interstate Commerce Commission in Accounting Matters

Realizing the increasing need and importance of correlating engineering and accounting to the fullest degree in filling the requirements of the Interstate Commerce Commission, the Board of Direction has tendered to the commission the services of the Association in any manner or matter that may be within its power, which offer has been most cordially and appreciatively received. The development of the federal valuation work has more prominently shown the interdependence of these departments in perfecting accounting accuracy and the securing of proper cost data for the engineer and operating man.

In particular the enforcement of Order No. 3 has advanced and emphasized this need and I am hopeful out of this offer of assistance may come some new and constructive service for our Association committees. Our work heretofore has been confined almost to a study of forms, but matters of joint interest to both departments are confronting us, not in trying to re-form the basic principle of accounting, but to make them of greater value to both the Railroad and the Government which under the new powers granted by Congress call for new data and measures.

The Interstate Commerce Commission has just asked us, by letter, to co-operate in the development of methods for charging depreciation and its application to existing accounting rules. I believe all concerned feel that in accounting classification we have drifted into a class of detail which has bedimmed the light and caused us to lose the greater and broader view and that out of the co-operative study contemplated by our offer we can all be benefited in simplifying but making more useful the records of such great importance. I would urge that the offer we have made be aggressively followed up.

Co-ordination with Other Committees

Through the activities of the American Railway Association for whom we perform the work of the Engineering division a contact has been established with the Mechanical division and with the Purchases and Stores division. The work of correlating the study of roadway and track structure with motive power and equipment is of increasing interest and importance. The tendency of the past for these two departments to work more and more independently has not been the ideal manner of procedure. Increasing wheel loads and the need for maximum clearances requires careful consideration of the demands upon track, roadway and structures. Likewise certain track and roadway details require consideration from the standpoint of equipment clearances.

Transportation conditions, changed as they are by new regulations as to hours of service, working conditions, the penalty from idle power, all call for new values to be ascribed to speeds, gradients, train loads, terminal delays, etc.—requiring greater co-ordination between the engineering, mechanical and operating divisions. This co-ordination is made easier by reason of the present organization of the American Railway Association and should be encouraged.

Relations with Other Engineering Bodies

During the year the Association became a member of Engineering Council, a federated body composed of the four founder societies and several other technical bodies, the purpose being to co-operate in matters affecting the welfare and progress of the profession and of interest to

all engineers. The board felt that such affiliation was desirable and proper. In the interim, however, a body of different origin and character has been proposed to take the place of Engineering Council and has been organized. The majority of the members of Engineering Council have voted to become members of the new body and by such action the greater elements of support were taken away from Engineering Council, rendering it inoperative.

The American Railway Engineering Association was invited to become a charter member, but having agreed to support the Council your Board felt it inexpedient to do so because it felt it could not commit your Association to the financial burden at this time and because it felt the plan of organization to be objectionable and by such action also urged that the Engineering Council be continued. The opportunity to become a charter member was of limited duration but the way is still open for the Association to become a member and which action should be by a referendum vote if it appears desirable and financially possible to consider such connection.

New Problems Confronting the Association

I have briefly referred to new conditions surrounding the construction, maintenance and operation of railways as a result of the many changes of the past two or three years. It is not necessary to discuss causes, but the practical effects—and their influence upon our work.

The Association has already sensed the need of giving relatively more attention to economics and committee assignments for two or three years past embody prominent references thereto. This necessity has increased by reason of the existing wage schedules and working conditions—whereby different values are given to the various operations of railway service.

These changes affect all activities and call for new formulæ—new values and new ideals. They include: Greater costs of equipment with greater loss from idleness, higher values for speed against tonnage performance, where overtime is excessive, increased per diem needing higher average daily car movement, the application of the shorter working day and the adverse and wasteful effect upon that class of work requiring the transportation of employees. These things all must be related to transportation economics and developed cooperatively.

I want to take this opportunity to express upon behalf of the Board the splendid work and loyal support which you have given in the conduct of the year's work. The year has been a difficult one in many ways. The change from federal control to private control meant a great deal of confusion in the reorganization of the railway service, particularly disturbing the work of the engineering department, and your Association work has been done under hardships, but you have done well and I commend that service to my successor with a feeling of deep personal gratitude.

Report of the Secretary

Financial Statement

The detailed financial statement for the calendar year 1920 shows:

Receipts from all sources	$37,631.37
Disbursements	38,386.55
Excess of Disbursements over Receipts	$ 755.18
Investments and Cash Assets, January 1, 1921	$42,989.22

Ten numbers of the Bulletin and the annual volume of Proceedings were issued during the year. The Proceedings for 1920 contain 1,500 pages, exceeding the volume of the preceding year by more than 500 pages of printed matter.

The Revised Manual

The republication of the Manual has been deferred until this year in order to include in the revision the important changes and additions submitted by the several committees for action at this convention. The Manual will be issued as promptly as practicable after the annual meeting.

The revised manual will contain the net results of the Association's work for the past 22 years. It is estimated the new volume will contain approximately one thousand pages.

Membership

The campaign for increasing the membership has resulted in the largest addition to the membership roll within a like period in the history of the Association. Since the inauguration of the campaign—January 27, 1920—521 applications have been received. A portion of this increase was included in the report made last year. The credit for this gratifying condition is due primarily to the earnest efforts of L. A. Downs, chairman of the Special Committee on Increase of Membership; and, secondly, to the hearty co-operation of the individual members of the several roads.

The following is a report on the present membership of the Association:

Membership at last annual meeting		1,638
Deceased members	18	
Resignations and dropped	33	
	— 51	
Additions during the year	364	
Net gain		313
Total membership March 1, 1921		1,951

Your Association has continued to actively cooperate with other technical bodies in the study of problems of mutual interest. The extent and scope of such cooperation has been clearly and comprehensively set forth in the address of the president.

Respectfully submitted,

E. H. Fritch, Secretary.

Financial Statement for Calendar Year Ending December 31, 1920

Balance on hand January 1, 1920 ..... $43,744.40

RECEIPTS

Membership Account	
Entrance Fees	$ 4,070.00
Dues	8,168.75
Subscription to Bulletins	8,168.75
Binding Proceedings and Manual	781.45
Badges	41.00
Sale of Publications	
Proceedings	2,695.60
Bulletins	1,127.88
Manual	360.95
Specifications	323.00
Leaflets	14.15
General Index	24.75
Advertising	
Publications	2,883.10
Interest Account	
Investments	1,677.50
Bank Balance	97.38
Annual Meeting	
Sales of Dinner Tickets	1,136.00
Miscellaneous	102.31
American Railway Association	
Rail Committee	5,958.80
Total	$37,631.37

DISBURSEMENTS

Salaries		$ 6,373.75
Proceedings		6,621.24
Bulletins		10,176.06
Manual		23.80
Stationery and Printing		1,344.56
Rents, Light, etc.		850.00
Telegrams and Telephone		27.41
Equipment		89.10
Supplies		126.19
Expressage		579.11
Postage		941.72
Exchange		84.00
Committee Expenses		57.97
Officers' Expenses		48.60
Annual Meeting Expenses		1,726.23
Refunds Dues Account Duplicate Payments, etc.		44.00
Audit		150.00
Engineering Council		1,099.77
Contribution to Joint Committee on Reinforced Concrete		100.00
Rail Committee		7,681.95
Miscellaneous		241.09
Total	$38,386.55	
Excess of Disbursements over Receipts		$ 755.18
Balance on hand, December 31, 1920		$42,989.22
Consisting of:		
Bonds	$40,565.65	
Cash in S. T. & S. Bank	1,752.97	
Cash on Hand	645.60	
Petty Cash	25.00	
	$42,989.22	

STRESSES IN TRACK FUND

Balance on Hand January 1, 1920	$ 1,036.29
Received from Interest During 1920	28.36
	$ 1,064.65

DISBURSEMENTS

Transportation	$ 8.20	
Hotel and Meals	2.40	
Supplies	99.20	$ 109.80
Balance on hand in Standard Trust and Savings Bank, December 31, 1920		$ 954.85

Respectfully submitted,
BOARD OF DIRECTION.

REPORT OF THE TREASURER

Balance on hand January 1, 1920		$43,744.40
Receipts during 1920	$37,631.37	
Paid out on audited vouchers, 1920	38,386.55	
Excess of disbursements over receipts		$ 755.18
Balance on hand December 31, 1920		$42,989.22
Consisting of:		
Bonds	$40,565.65	
Cash in S. T. & S. Bank	1,752.97	
Cash on hand	645.60	
Petty Cash	25.00	
	$42,989.22	

STRESSES IN TRACK FUND

Balance on hand January 1, 1920	$ 1,036.29
Received from interest during 1920	28.36
Total	$ 1,064.65
Paid out on audited vouchers during 1920	109.80
Balance on hand December 31, 1920	$ 954.85

The Securities listed above are in a safety deposit box of the Merchants' Loan & Trust Safe Deposit Company, Chicago.

Respectfully submitted,
GEO. H. BREMNER,
Treasurer.

Report of Committee on Ballast

In choice of ballast, gravel, where available, should receive careful consideration when it is properly screened, crushed and washed. Consensus of opinion is strongly against ballasting by contract in normal times and especially so on operated track. New and more complete specifications for stone ballast and washed gravel are submitted for inclusion in the Manual. Specifications have been made sufficiently flexible to meet conditions of available supplies for individual roads, while at the same time furnishing accurate comparisons with desired product. Requirements are well within limits of tolerance. Plans are submitted for tamping tools, etc.

H. L. Ripley
Chairman

H. L. Ripley, who is completing his second years as chairman, has been a member of the committee for five years. He is the second valuation engineer to direct the work of this important committee, having succeeded H. E. Hale, group engineer of the President's Conference Committee on Valuation in 1919. As valuation engineer of the New York, New Haven & Hartford he has had occasion to study many of the problems under consideration by the committee from the standpoint of their influence on the cost of a railway proper. His effective direction of the work of the committee is indicated by the fact that its report was completed early.

THE COMMITTEE RECOMMENDED that the revision and rearrangement of the subject-matter in the Manual as made in accordance with Appendix A be approved and the revised matter be substituted for the present recommendations in the Manual.

The committee recommended that the instructions to govern ballasting on an operated line, presented as a report of progress last year (*Railway Age*, March 18, page 917), be approved and printed in the Manual as recommended practice.

The committee recommended that Specifications for Stone Ballast Material, as presented in tentative form last year (*Railway Age*, March 18, page 918), be approved and printed in the Manual as recommended practice.

The committee recommended that Specifications for Washed Gravel Ballast, as outlined in Appendix D, be adopted and printed in the Manual as recommended practice.

The committee recommended that the standard ballast tamping bar, tamping pick, and ballast fork, as outlined in Appendix E, be printed in the Manual as recommended practice.

Committee: H. L. Ripley (N. Y. N. H. & H.), chairman; F. J. Stimson (Penna.), vice-chairman; C. W. Baldridge (A. T. & S. F.), O. F. Barnes (Erie), J. S. Bassett, W. J. Bergen

(N. Y. C. & St. L.), F. W. Bettle (T. & P.), Theo. Bloecher, Jr. (B. & O.), H. E. Boardman (N. Y. C.), C. J. Coon (N. Y. C.), T. W. Fatherson (C. G. W.), H. E. Hale, Paul Hamilton (C. C. C. & St. L.), G. H. Harris (M. C.), A. G. Holt (C. M. & St. P.), F. A. Jones (M. P.), J. S. McBride (C. & E. I.), S. B. Rice (R. F. & P.), D. L. Sommerville (N. Y. C.), Paul Sterling (N. Y. N. H. & H.), W. W. Thrower (I. C.), R. C. White (M. P.), W. D. Williams (C. N.).

Appendix A—Revision of Manual

Definitions

General

Ballast.—Selected material placed on the roadbed for the purpose of holding the track in line and surface.

Sub-Ballast.—Any material of a character superior to that in the adjacent cuts, which is spread on the finished sub-grade of the railroad and below the top-ballast, to provide better drainage, prevent upheaval by frost, and better distribute the load over the roadbed.

Top-Ballast.—Any material of a superior character spread over a sub-ballast to support the track structure, distribute the load to the sub-ballast, and provide good initial drainage.

Foul-Ballast.—Ballast which has lost its porosity through the filling up of the voids by cinders, coal dust, dirt or other foreign matter.

Dust.—Fine particles of sand, clay, loam, or other earthy matter which will pass through a No. 50 screen.

Shoulder.—That portion of the ballast between the end of the tie and the toe of the ballast slope.

Crib.—That portion of the ballast between two adjacent ties.

Depth.—The distance from the bottom of the tie to the top of the sub-grade.

Kind

Chats.—Tailings from mills in which zinc, lead, silver, and other ores are separated from the rocks in which they occur.

Chert.—An impure flint or hornstone occurring in natural deposits.

Cinders.—The residue from the coal used in locomotives and other furnaces.

Clay (Burnt).—A clay or gumbo which has been burned into material for ballast.

Granite (Disintegrated).—A natural deposit of granite formation, which on removal from its bed by blasting or otherwise, breaks into particles of size suitable for ballast.

Gravel.

(a) Pit Run.—Worn fragments of rock and sand occurring in natural deposits.

(b) Screened.—Worn fragments of rock, occurring in natural deposits, that will pass through a 2½-inch ring and be retained upon a No. 10 screen.

(c) Washed Gravel.—A gravel from which foreign matter has been washed and the relative proportions of gravel and sand have been determined.

Gumbo.—A term commonly used for a peculiarly tenacious clay, containing no sand.

Sand.—Any hard, granular, comminuted rock which will pass through a No. 10 screen and be retained on a No. 50 screen.

Slag.—The waste product, in a more or less vitrified form, of furnaces for the reduction of ore; usually the product of a blast furnace.

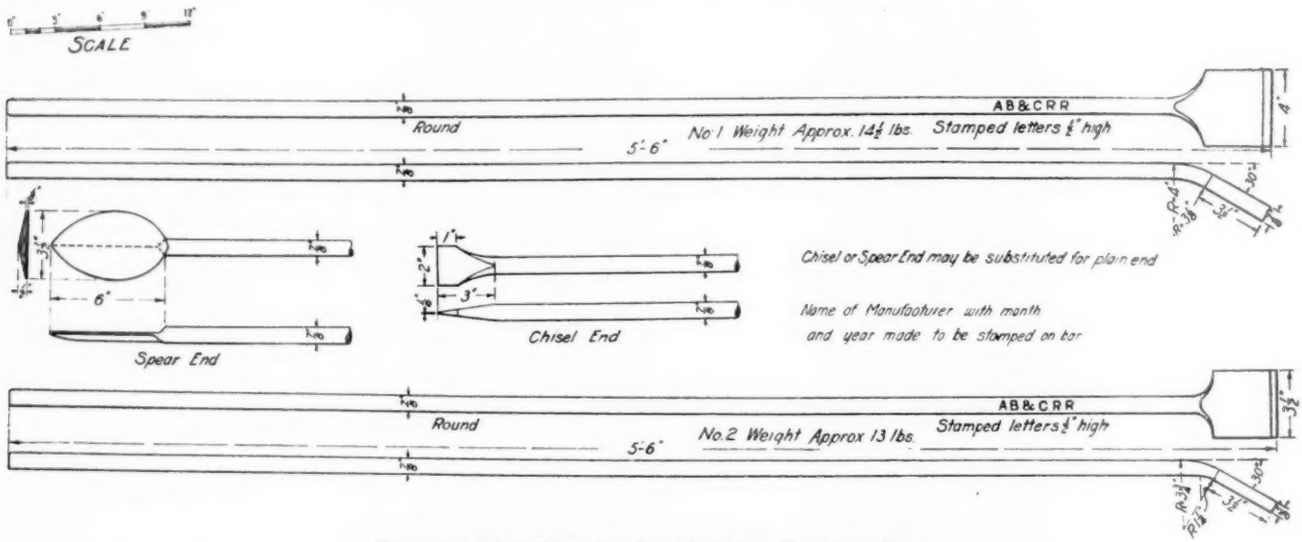
Stone.—Stone broken by artificial means into small fragments of specified sizes.

Comparative Merit of Material for Ballast

The following sets forth the relative order of effectiveness of various kinds of ballast:

(1) Stone
- (a) Trap rock.
- (b) Limestone.
- (c) Sandstone.

(2) Washed Gravel


Scale
Round
No.1 Weight Approx. 14½ lbs.
Stamped letters ½" high
AB&CRR
5'-6"
Spear End
Chisel End
Chisel or Spear End may be substituted for plain end
Name of Manufacturer with month and year made to be stamped on bar
No.2 Weight Approx 13 lbs.

Recommended Plan for Standardized Tamping Bars

(3) Broken slag (not granulated)
- (a) Precious metal slag.
- (b) Open-hearth slag.
- (c) Blast furnace slag.

(4) Screened Gravel

(5) Pit Run Gravel
- (a) River or stream gravel.
- (b) Hill gravel (not cementing).
- (c) Hill gravel (cementing).

(6) Chats
- (a) Chats from zinc ore, which is coarse.
- (b) Chats from lead ore, which is fine.

(7) Burnt Clay or Gumbo

(8) Cinders
- (a) Hard coal cinders.
- (b) Volcanic cinders.
- (c) Soft coal cinders.

Natural ballast materials vary greatly in quality, and the choice must often be determined by availability and expediency under the particular existing circumstances. Financial conditions may control the choice or there may be only one suitable material readily available. Crushed stone is a manufactured article and, the process being under control, it is practicable to make the product conform to specifications. In the choice of ballast where gravel is available, it should receive careful consideration, as it has given excellent results, especially when properly screened, crushed and washed.

Proper Depth of Ballast

(a) On a roadbed material such as clay, loam, etc., subject to deformation by the application of live load, the proper depth of ballast under the tie to produce approximately uniform pressure on the roadbed would be not less than the spacing center to center of the ties. For

Class A track, see ballast sections, adopted March, 1918.

(b) On material that approximates the character of good sub-ballast (which will not be deformed by the application of live load), the minimum depth of ballast under the bottom of the tie should be 12 in.

(c) These depths are required, under the conditions named, to support the track structure; to provide good initial drainage; to provide against upheaval by frost; to serve as a cushion for the track.

(d) A combination of a good sub-ballast 18 to 14 in. and top-ballast 6 to 10 in., making a total of approximately 24 in. under the tie in the aggregate, will produce nearly the same result as though the superior material was used for the full depth.

(e) Until sufficient tests are made under normal traffic conditions, the proper depth of ballast under the tie must rest on opinion, based on experience and supported by such tests as are available, notably the test made by Director Schubert of the German Railways and the "Altoona Test" made by the Pennsylvania Railroad.

(f) Proper drainage of the sub-grade is essential to success with any kind of ballast.

Characteristics of Stone Ballast

(1) Stone ballast should be sufficiently durable not to disintegrate in the climate where used, hard enough to prevent pulverizing unduly under the action of tools or traffic, and should break with an angular fracture when crushed.

(2) It should be broken into pieces of such size that they will in any position pass through a 2½-in. ring and will not pass through a ¾-in. ring.

(3) It should be free from dirt, dust or rubbish.

(e) Toughness, maximum.

(f) Cementing value, minimum.

(g) Compression test, maximum.

The above physical tests are made uniformly and free of charge by the Department of Agriculture, U. S. Government, Washington, D. C. Much valuable information in regard to tests already made and tabulated can also be obtained from this department.

Specifications for Pit Run Gravel Ballast

For Class A Railways: Bank gravel, which contains more than 2 per cent dust or 40 per cent sand, should be washed or screened.

For Class B Railways: Bank gravel, which contains more than 3 per cent dust or 60 per cent sand, should be screened or washed. Screened gravel should not contain less than 25 per cent nor more than 50 per cent sand.

For Class C Railways: Any material which makes better track than the natural roadbed may be used economically.

Method of Testing Quality of Pit Run Gravel for Ballast

(1) The size of the sample to be tested should be approximately 1 cubic foot.

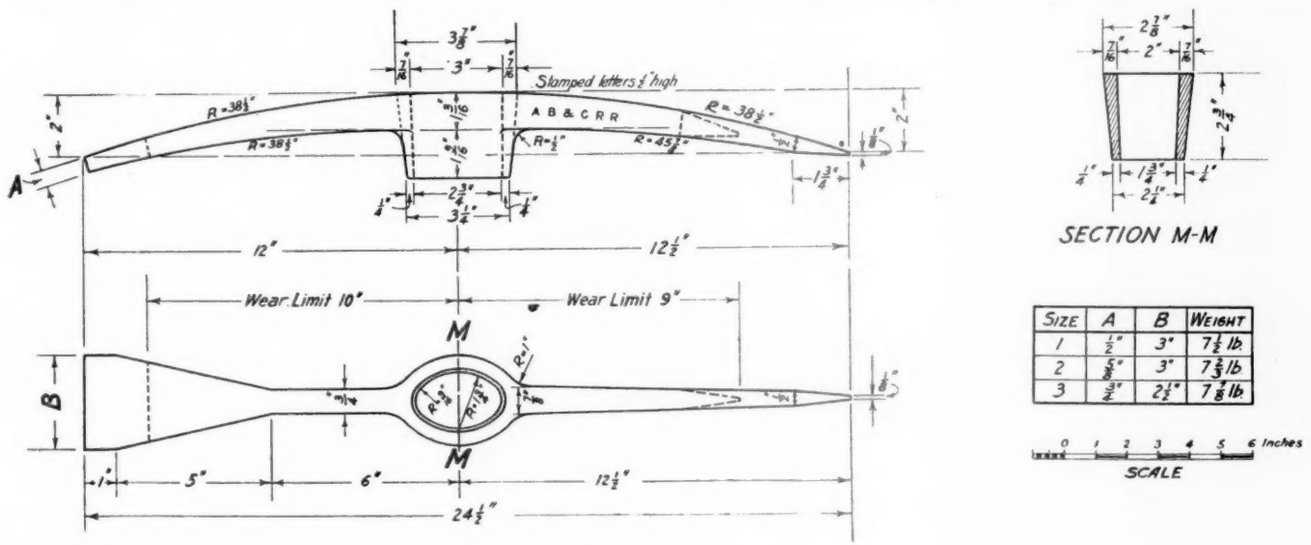
(2) Five average samples of about one cubic foot each should be selected from various parts of the pit which is to be tested. The five samples should then be thoroughly mixed and about one cubic foot of the mixture selected for testing.

(3) To separate the gravel from the sand and dust, use a No. 10 screen, 10 meshes to the inch, made of No. 24 wire, B. & S. gage. To separate the sand from the dust, use a No. 50 screen, 50 meshes to the inch, made of No. 31 wire, B. & S. gage.

(4) Measure the percentage of gravel, sand and dust taken from the sample by volume, giving the percentage of each ingredient compared to the volume of the sum of the ingredients, as follows:

$$\text{Per cent of sand} = \frac{S}{G + S + D}$$

Where S = Volume of sand
G = Volume of gravel
D = Volume of dust



Size	A	B	Weight
1	½"	3"	7½ lb.
2	⅝"	3"	7⅝ lb.
3	¾"	2½"	7⅞ lb.

Name of Manufacturer with month and year made to be stamped on pick

Recommended Plan for Standardized Tamping Picks

Attention is called to the physical test of stone for ballast given below, which is recommended as a guide in connection with the specifications, or where a quick test must be substituted for a more complete examination.

Other things being equal, the maximum or minimum results, as indicated, will govern in selecting stone for ballast:

(a) Weight per cubic foot, maximum.

(b) Water absorption in pounds per cubic foot, minimum.

(c) Per cent of wear, minimum.

(d) Hardness, maximum.

(5) When sample is shipped for test it should be marked carefully and securely with the name and location of the pit from which it was taken.

Cinder Ballast

The use of cinder as ballast is recommended for branch lines with light traffic; on sidings and yard tracks near the point of production; as sub-ballast in wet, spongy places, on new work where embankments are settling, and at places where the track heaves from frost. It is recommended that provision be made for wetting down cinders immediately after being drawn. A sub-ballast blanket of cinders not less than 12 in. thick is effective in most cases in preventing mud and similar material working up into the top-ballast.

Specifications for Burnt Clay Ballast

1. **Kind of Material.** Good ballast clay is heavy and plastic, free from sand, gypsum or other impurities. It must not crumble when exposed to air or when brought in contact with heat.

2. **Location.** The pit should be located on level or moderately sloping ground, not subject to overflow. A water supply is desirable and it should be borne in mind that the sulphurous and carbonaceous gases liberated during the burning period, damage the surrounding vegetation and make habitation in the near vicinity very disagreeable.

3. **Test.** The location site should be thoroughly tested to determine quality of clay, depth and uniform consistency of deposit, and small quantities should be burned in test kilns to show the quality of ballast to be secured.

4. **Burning.** Fuel should be fresh, clean slack, and arrangements should be made to secure constant supply. One ton of slack coal is generally sufficient for the perfect burning of four cubic yards of acceptable ballast. From one to one and one-half-inch layer of slack is alternated with from ten to twelve-inch layer of clay, a new layer of slack and clay being applied to the fire every five or six days. Fires once started must be kept burning steadily and uniformly. To insure thorough and proper burning of the clay, the top and face of the fire should be frequently raked down, to avoid clinker or black spots, caused by too much or too little air. When fully burnt a proper ballast clay becomes red in color, when the clay contains iron; when under-burnt, the clay will show a yellow color.

5. **Size.** Burnt clay ballast should be crushed or broken, if necessary, so that the largest piece will pass through a 4-inch ring.

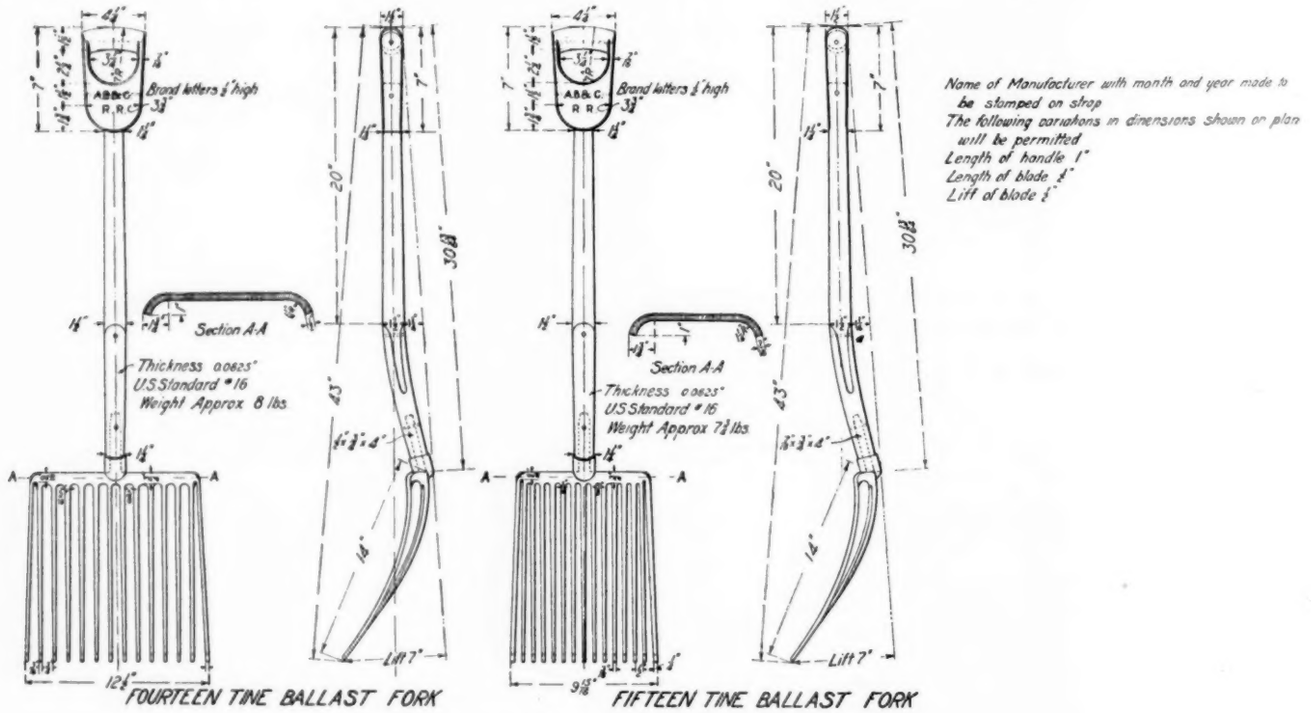
6. **Density.** The finished product should absorb not to exceed 15 per cent of moisture by weight.

Cleaning Foul Ballast

Under usual conditions no ballast, except stone or hard slag, should be cleaned. Ballast should be cleaned when foul enough to prevent proper drainage. Clean with ballast forks or screens. Clean shoulder down to sub-grade. Clean crib to bottom of ties. Clean space between tracks to depth of 6 in. or more below the bottom of ties. Clean the berme to bottom of ballast, preferably not less than 12 in. below bottom of tie. Clean cross ditches between ties approximately every rail length, or 33 ft. Cross ditches should not be under rail joints. Return ballast when cleaned and apply sufficient new ballast to produce the standard section.

Tests, fully described in the report of the Committee on Ballast for 1914, indicate stone ballast can be cleaned by use of screens for approximately one-half cost of cleaning stone ballast with forks.

Stone ballast should be cleaned in terminals, at intervals of 1 to 3 years, under heavy traffic at intervals of 3 to 5 years, under light traffic lines at intervals of 5 to 8 years. Per cent of new stone ballast to be applied, 15 to 25 per cent.


Brand letters ½" high
A B & C R R C
Section A-A
Thickness .0625" U.S Standard #16 Weight Approx 8 lbs
Thickness .0625" U.S Standard #16 Weight Approx 7½ lbs
Name of Manufacturer with month and year made to be stamped on strap
The following variations in dimensions shown on plan will be permitted
Length of handle 1"
Length of blade ½"
Lift of blade ½"
Lift 7"
FOURTEEN TINE BALLAST FORK
FIFTEEN TINE BALLAST FORK

Recommended Plans for Standardized Ballast Forks

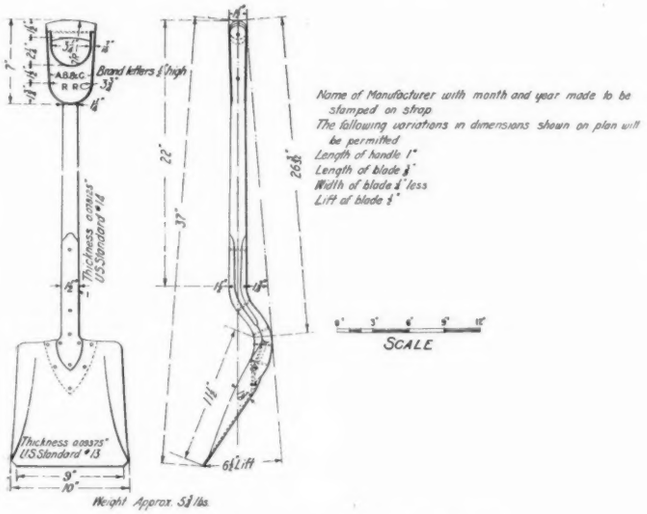
Use and Limitation of Mechanical Tools

Mechanical devices used to save labor and expense and to expedite the work fall naturally into sequence from the pit, quarry or ballast pile to the finished track. Cars for transporting ballast should be chosen carefully with regard to the work to be done—whether it is to be on track already laid or for an additional parallel track. If for raising track, hopper cars should be used with the ballast plow or tie drag. If for parallel track, side dumps are to be preferred, especially when air operated. Convertible cars where the sides swing out and up, when used with the side plow and unloading engine-drum and

cable, are fairly satisfactory when dump cars are not available, which is usually the case when stone ballast is furnished from a private quarry. Anchoring the train and pulling the plow through the train by cable from the locomotive is a poor substitute for the unloading engine. It does beat unloading by hand.

The spreader car, especially when air-operated, is effective and should be in general use. With this car ballast for new second track work previously dumped alongside the running track from side dump cars or unloaded by side plows, can be spread out to a grade two inches below the bottom of tie and to the outside shoulder at a speed of eight miles per hour. When not in use on ballast work the spreader can be used on a grading dump and in wet clay or rock, will do the work of fifty men and remain idle most of the time at that.

The mechanical tamper has passed the stage where its usefulness under favorable circumstances needs further


A.B.&C. R.R.Co.
Brand letters 1" high
Name of Manufacturer with month and year made to be stamped on strap
The following variations in dimensions shown on plan will be permitted
Length of handle 1"
Length of blade ½"
Width of blade ¼" less
Lift of blade ¼"
Thickness across U.S.Standard #14
Thickness across U.S.Standard #13
SCALE
Weight Approx. 5¾ lbs.

Suggested Type of Ballast Shovel

defense. Around terminals and yards where there is a large amount of frog and switch work, so far as this committee knows there is no disposition to question the expediency of its use based on its merits alone, entirely apart from any question of scarcity of labor.

The consensus of opinion is strongly against ballasting by contract in normal times and especially so on operated track. Advocates of ballasting by contract do so largely as an emergency measure because of the greater flexibility of a contractor's organization in changing the rates of pay and so securing labor in times of stress.

Concrete slabs placed under the ballast on soft roadbed where traffic is heavy, and at times under other exceptional circumstances, indicate that a considerable degree of success may be expected from their use, and at reasonable expense.

Appendix D—Specification for Washed Gravel Ballast

1. Gravel for ballast shall be so prepared that dust, loam and dirt are removed, that all aggregates that will not in any position pass through a 2½-in. ring are rejected; and that the sand contained in the ballast shall not, in volume, exceed 20 per cent nor be less than 15 per cent of the material as loaded for use.

Test No. 1. Dust, Dirt or Loam

2. A sample of the prepared ballast containing ⅛ cu. ft. shall be placed in a watertight receptacle having a capacity of not less than 1 cu. ft. Into this receptacle shall then be placed two quarts of clear water, after which the receptacle shall be agitated until the gravel is thoroughly washed. The water shall be drained off immediately and placed in a glass jar and allowed to settle. If the sediment deposited in the bottom of the jar is more than ½ of 1 per cent of the volume of sample the output of the plant shall be rejected until the fault has been corrected.

Test No. 2. Large Aggregate

3. A sample weighing not less than 150 lb. shall be placed in or on a screen having round holes 2¾ in. in diameter. If a thorough agitation of the screen fails to pass through the screen 98 per cent of the material, as determined by weight, the output from the plant shall be rejected until the fault has been corrected.

Test No. 3. Sand

4. One cubic foot of the prepared ballast shall be thoroughly dried, placed in a screen having ten meshes to the inch and the screen agitated till all particles which will pass have passed the screen. If the material which passes through the screen exceeds 20 per cent or is less than 15 per cent in volume of the original sample the output shall be rejected until the fault has been corrected.

5. In case inspection develops the fact that the material which has been or is being loaded is not in accordance with these specifications, the inspector shall notify the manufacturer to stop further loading until the fault has been corrected, and to dispose of all defective material that had been loaded in cars, which shall be done at the expense of the contractor.

6. When ballast is being paid for by the ton, and it is impracticable to weigh each car, the weight per yard shall be obtained by weighing at frequent intervals not less than five cars loaded with ballast, the contents of which have been carefully measured. The weight per yard obtained by such a test shall be used in figuring the weight per car until another test is made.

7. When ballast is paid for by the yard, the amount shall be determined by weighing each car, where practicable, and applying the weight per yard as determined by frequent tests. When impracticable to weigh each car, the contents of each car will be carefully estimated by comparison with cars, the contents of which have been actually measured.

Appendix E—Standardization of Ballast Tools

The sub-committee submitted specifications and plans for tamping bars, tamping picks and ballast forks, which were recommended for insertion in the Manual.

The committee also submitted a plan for a standard ballast shovel which it requested be considered as a progress report.

Specifications for Ballast Tools

Scope

1. These specifications cover tamping bars, ballast forks and tamping picks.

Material

2. These tools, other than straps, shall be high-grade tool steel made by the open-hearth or crucible process.

3. Straps for forks shall be of soft open-hearth steel or wrought-iron.

4. Handles shall be smooth and well seasoned, of the best grade straight grained ash or hickory, bent to shape.

Chemical Properties

5. The steel shall conform to the following chemical composition:

	Tamping Bars and Picks Per Cent	Forks Per Cent
Carbon	0.55 to 0.75	0.90 to 1.05
Manganese	0.40 to 0.60	Not more than 0.50
Phosphorus	Not more than 0.04	Not more than 0.04
Sulphur	Not more than 0.04	Not more than 0.04

Design

6. The dimensions of tools shall conform to the plans which are made a part of these specifications.

Physical Properties

7. All tools shall be free from defects and finished in a workmanlike manner.

8. Tools must be properly tempered to provide the maximum toughness and strength to perform the service for which they are intended.

9. Tamping bars, picks and tines, head and tongue of ballast forks shall be of one piece, no welding being permissible.

10. Tools shall be marked as shown on the plans.

Inspection

11. Inspection of tools shall ordinarily be made at the place of manufacture. The manufacturer shall notify

..... of the Railroad Company at least ..... days in advance when tools will be ready for shipment. However, when so directed, in regard to a particular shipment, the manufacturer shall make shipment on his own inspection, subject to requirements of Paragraph 15.

12. The manufacturer shall allow the railroad company's inspectors such access to the work as may be necessary to satisfy them that the provisions of these specifications are carried out.

13. The manufacturer shall furnish, without charge, all necessary facilities and assistance for making thorough inspection and tests at the works.

Rejection

14. Individual tools, defective in any respect, and lots of tools not meeting above requirements, shall be rejected.

15. All tools shipped on manufacturer's inspection, as provided in Paragraph 11, which on arrival at destination are found defective and all tools which develop flaws and defects in the usual and necessary service, shall be rejected and replaced at the entire expense of the manufacturer or seller.

Discussion

H. L. Ripley (Chairman): The work of the ballast committee for the past year has been largely in the nature of a review of the tentative report presented a year ago. It has been reviewed and corrected by the members of the committee.

C. W. Baldridge (A. T. & S. F.): The instructions to govern ballasting on an operated line were presented to the Association last year as information, with the statement that they would be presented this year for adoption for inclusion in the Manual. Some few changes have been made since that time by the committee. These instructions are intended as a guide to anyone who may care to look up something in regard to recommended practice on ballasting or reballasting of track.

Chairman Ripley: *I move the adoption of Appendix B, to be printed in the Manual as recommended practice.*

(*Motion carried.*)

Chairman Ripley: The next matter covered by the committee is Appendix C, on specifications for stone ballast material. In offering these, the committee realizes fully that it is not possible to write precise specifications for stone for ballast as can be done with specifications for steel, for instance, because the original material is not capable of the same treatment and one is compelled to use the raw material available. *I move the adoption of Appendix C for inclusion in the Manual.*

(After some discussion relating to details of wording *the motion was carried.*)

Chairman Ripley: Appendix D refers to a matter not directly referred to the committee, Specification for Washed Gravel Ballast. It seemed so closely allied to the subject that was specifically given to the committee for consideration and was a matter which some members of the committee themselves found they were very much interested in at this time that the committee has drafted this set of specifications, which does not do violence to the other set just read, and should go into the Manual.

J. E. Willoughby (A. C. L.): In connection with the first item of the specification I notice it is proposed that the sand for the washed gravel ballast shall not exceed 20 per cent. I believe it is the more general custom where washed gravel ballast is used that the sand may exceed 20 per cent. On the Atlantic Coast Line we use it up to 25 per cent and 33 per cent. We have a good deal of rain and do not have any trouble from the amount of sand causing the retention of the water. The soils on which the ballast is placed, however, are usually sandy soils. In our practice we remove all sand and remix the sand and gravel and the sand is that ordinarily found in our sand pits and will pass through a ⅜-in. screen.

Chairman Ripley: Under the conditions found on the line of the Atlantic Coast Line that is perfectly permissible. This is recommended, not as a standard, but recommended practice to carry us under normal average conditions. The committee would not oppose making that 25 per cent if it seems good to the membership. The committee, however, is pretty thoroughly in accord, if not unanimous, in suggesting the percentages named here, and would be, frankly, more likely to reduce the 15 per cent than to add to the 20 per cent, based on the experience of two members of the committee who have used washed gravel very extensively and lately have had experience with it.

The Chairman: Did the committee take into consideration the fact that oftentimes a different specification might be required for washed gravel sand proportion, in the case of bank washed gravel, as compared with river-bed washed gravel, the difference being largely due to the fact that in the river bed material the larger particles are quite smooth and round, while with certain classes of bank gravel that are washed the aggregate is rough.

Chairman Ripley: Yes, that matter was considered by the committee. We put down a trial section of that track with ball-bearing gravel, as it is called, containing seven per cent sand, and it held its line, held its grade and there was no difficulty experienced. I have no objection to lowering the minimum 5 per cent or raising the maximum 5 per cent. I believe, however, as a guide under normal conditions the percentages named are better than would be the case if a change was made either lowering or raising the limit of tolerance. *I move Appendix D be adopted and included in the Manual as recommended practice.*

(*Motion carried.*)

Chairman Ripley: Appendix E, Standardization ballast tools. This matter has been before the convention for two years, and the report will be made by the chairman of the sub-committee, Mr. McBride.

(J. C. McBride (C. & E. I.) submitted Appendix E.)

Chairman Ripley: *I move the adoption of Appendix E, excepting ballast shovel specifications, be placed in the Manual as recommended practice.*

The Chairman: May I ask the committee whether in the designs of these tools there are any radical changes that will induce any manufacturing difficulties?

Chairman Ripley: I think we can say positively, no; although the manufacturers have not responded to our request for criticism; but these tools were the composite result of a questionnaire sent out by different carriers, and pretty well responded to.

(*The motion to adopt Appendix E was carried.*)

Chairman Ripley: The other matter is the revision of the Manual. We request permission to suggest to the committee editing the Manual that the matter be rearranged and worded as stated in Appendix A.

Mr. Willoughby: I take it that it was one of the duties of the committee to ascertain if the existing specifications on which no change is made fulfil what is now good practice, regardless of whether the convention have heretofore adopted the definition. In Appendix A there is a definition for sub-ballast: "Any material of a character superior to that in the adjacent cuts." Now, the material in the adjacent cuts is sometimes very good ballasting material. Sometimes it may be gravel, it is possibly stone and it is frequently sand, all of which may be good ballast, not only in sub-ballast, but in ballast. The purpose of the sub-ballast is to cover the roadbed. The sub-ballast material ought to be material which is better than the material underneath the roadbed.

Chairman Ripley: Mr. Willoughby, taking the condition that you have stated, isn't it an open question, whether it is ballast or not, or whether you would handle it as ballast? If you went through a cut with material of that

nature you would not take it out only to a certain depth. If the adjacent fill was made with that material, you would make it up to a certain depth. I wonder whether under such conditions material handled out of that cut below a final ballast would be considered and handled as ballast at all?

Mr. Willoughby: There is a condition in certain parts of the country, for instance, Florida, where the state is overlaid generally with a layer of sand that is sometimes 20 ft. or more in depth. In the cutting you will pass through sand, and sand would be in the adjacent cut. Sand will make good sub-ballast, but not good ballast, on account of its lightness in blowing away. Now, the cut may be sand itself and you would not be entitled under that classification to call the sand which you placed on the roadbed sub-ballast.

Chairman Ripley: I think your point is well taken. I wonder if that definition should not be made to read: "Any material of a superior character which is spread on the finished sub-grade of the roadbed and below the top-ballast, to provide better drainage, prevent upheaval by frost, and better distribute the load over the roadbed. Is that satisfactory to you, Mr. Willoughby?

Mr. Willoughby: That is satisfactory to me.

H. Austill (M. & O.): In Appendix A, does the definition of screened gravel represent gravel in the pit that may be screened?

Chairman Ripley: The basic idea was to get a certain product, and that product is one that has no stone in it that is larger than 2¼ in. in diameter, and has nothing smaller in it than will be held on a No. 10 screen.

Mr. Campbell: I would suggest that that be made to read: "Worn fragments of rock occurring in natural deposits that have been passed through a 2½-in. ring and been retained on a No. 10 screen.

Mr. Ambrose: How would it be if you were to simply treat it as a noun and cut off the letters "ed" and leave it stand as it is? *I move that the "ed" be deleted.*

The Chairman: The motion is that the caption should read "screen gravel" instead of "screened gravel."

(*Motion carried.*)

J. M. R. Fairbairn (C. P. R.): In the figures we are passing on for the Manual, is there any special reason why in these diagrams the crown of the sub-grade has been left off? It seems to me it would be better to show the crown of the sub-grade as it is shown to the committee on roadway.

Chairman Ripley: I know of no reason why the bottom should not be made to conform, but it would require special action by the Association to do so.

Mr. Fairbairn: *I move that the sub-grade be shown with a crown in these diagrams similar to that used by the Roadway committee report.*

Mr. Frink: The committee on roadway this year is presenting some diagrams of roadway sections with the sub-grade crowned. It is my recollection our Manual now contains diagrams with the sub-grade at the level and therefore this presentation of the committee on roadway is a change in the Manual.

(*Motion carried.*)

(The committee was dismissed with the thanks of the Association.)

Report of the Committee on Electricity

The electrification of the Norfolk & Western is described in the report on water power. All phases of the work, including operating conditions, operating cost, classes of equipment, purchase of power, conservation of fuel and saving of wages are discussed. It is concluded that a saving of at least 12½ per cent of the total annual expense will be obtained by a system of electrification as compared with steam operation under similar condition. Specifications for wires and cables, underground conduit construction and tungsten lamp standards are presented for adoption in the Manual. Marked economies can be effected by the use of a restricted number of different lamps.

Edwin B. Katte
Chairman

Edwin B. Katte has been associated with the work of the Committee on Electricity since 1911, and for the last four years he has been the chairman. No man has had a better training for the leadership of this important committee than Mr. Katte. Being associated with the electrification of the New York Central's Manhattan terminal since its very inception and occupying the position of chief engineer of electric traction, he has had an extended first hand contact with steam railway electrification from the viewpoint of both construction and operation. This experience is of great value to the committee when the subject of electrification is receiving so much attention.

In Appendix A of the report the committee reported on the subject of electrolysis and its effect on reinforced concrete; in Appendix B, water power for electric railway operation; in Appendix C, railroad specifications for electric wires and cables.

In Appendix D the committee reported on the subject of electrical interference, and in Appendix E, railroad specifications for underground conduit construction for power cables for approval and printing in the Manual as recommended practice; also definitions of additional electrical terms for printing in the Manual.

Conclusions

1. The committee recommended for inclusion in the Manual the additional electrical definitions enumerated in Appendix E.

2. The committee recommended that the report on electrolysis and insulation, being Appendix A, be accepted as information and published in the Proceedings.

3. The committee recommended that the report on water power, being Appendix B, be accepted as information and published in the Proceedings.

4. The committee recommended that the railroad specifications for wires and cables, being Appendix C, be approved and printed in the Manual as recommended practice.

5. The committee recommended that the report on electrical interference, being Appendix D, be accepted as information, published in the Proceedings.

6. The committee recommended that the railroad specifications for underground conduit construction for

power cables, being Appendix E, be approved and printed in the Manual as recommended practice.

7. The committee recommended that the report on the National Electrical Safety Code, being Appendix F, be accepted as information, published in the Proceedings and that the committee be authorized to continue its coöperation with the United States Bureau of Standards.

8. The committee recommended that the railroad specifications for incandescent lamps, being Appendix G, be approved and printed in the Manual as recommended practice.

Committee: Edwin B. Katte (N. Y. C.), chairman; D. J. Brumley (I. C.), vice-chairman; H. M. Bassett (N. Y. C.), R. D. Coombs (Cons. Engr.), Walt Dennis (Wabash), A. H. Hogeland (G. N.), C. E. Lindsay, W. L. Morse (N. Y. C.), R. S. Parsons (Erie), M. Schreiber (P. S. R of N. J.), W. M. Vandersluis, R. Beeuwkes (C. M. & St. P.), J. C. Davidson (N. & W.), R. H. Ford (C. R. I. & P.), G. W. Kittredge (N. Y. C.), H. K. Lowry (C. R. I. & P.), A. E. Owens (C. R. R. of N. J.), J. R. Savage (L. I.), E. B. Temple (P. R. R.), S. Withington (N. Y. N. H. & H.).

Appendix B—Water Power

The report on water power consists of a description of the Norfolk & Western's electrification, covering in the first part such subjects as operating features, types of locomotives, power house problems, etc. This project has been described on varying occasions in the *Railway Age*, the latest article being on page 101 of the January 7, 1921, issue. The last half of the report deals with the questions of purchasing power, operating costs, etc.

Purchasing Power

The question has been frequently asked why the company installed a steam-driven plant for power generation when hydro-electric power was available. At the time when plans for electrification were being perfected, this subject was studied in detail and the decision to generate by steam was arrived at after careful consideration. There were two main factors involved; first, the question of cost; second, continuity of supply. In 1913 and 1914, power station coal could be placed in the railway company's bunkers at less than one dollar per ton, and on this basis power could be produced more cheaply than it could be purchased. With the present high prices of this coal, the comparison is on an entirely different basis. As to continuity of power, hydro-electric concerns in the vicinity are affected materially by shortage of water at certain seasons of the year, and at the time electric operation was decided upon, very little steam reserve power was available. It was felt that it would be unwise for the railway to rely upon an outside source of power which was liable to interruption from shortage of water or other causes. Through the emergency connection with the Appalachian Power Company, the railway has frequently had to supply power to enable the hydro-electric company to maintain its service.

In 1916, a reciprocal agreement was effected between the railway company and the Appalachian Power Company whereby, in emergency, either company would supply the other with power. Under the terms of this agreement, the power company installed at its own cost in its plant at Switchback, a frequency changer with connections to the railway company's substation at Maybeury. The amount of power which can be transferred is, of course, limited by the capacity of the frequency changer, which is 10,000 kilowatts. All power exchanged is metered at the power company's side of the apparatus and consequently the railway stands all loss of transmission and conversion. As a partial compensation, the power company paid for power supplied 33 per cent more than the railway company paid for power received. Payments originally were based on a flat rate per kilowatt hour.

Due to the great advance in cost of coal, a supplementary agreement was put into effect in 1918, whereby a sliding scale adjustment was applied to the price charged the power company to cover increase in cost of coal. No change was made in the price for hydro-electric power received from the power company, but provision was made that in the event of steam generated power being received from the power company from their steam reserve plants, the railway company would pay for this steam power on the same basis as the power company pays the railways. No adjustments have yet been made to cover increased cost of labor and material.

Under present conditions, the advantages of these emergency connections are slight insofar as the railway company is concerned. The amount of power available at any time is insufficient for traction purposes without keeping the railway company's Bluestone plant in complete operation. At times, it has been possible to use the power company's supply and shut down one machine. There is, however, a distinct advantage due to the fact that the operation of the frequency changer can be handled so as to improve the system power factor of the railway. The use of the frequency changer as a condenser increases the power factor by 10 to 15 per cent.

Operation Costs

As the electric service now maintained is on an entirely different basis from the former steam service, it is impossible to give a direct comparison of cost. It has therefore been considered advisable to give the following comparison between steam and electric freight locomotive operation, using the records and figures compiled for use in the company's annual report. In this comparison, all costs entering into operation as well as interest and depreciation have been taken into account and while the figures are necessarily approximate it is believed they are sufficiently close to be representative:

Comparative Cost Per Million Tractive-Miles

Items	*Steam*	*Electric*
Interest and depreciation	$ 4.36	$12.16
Repairs	7.64	6.40
Fuel of elec. power at loco	13.00	6.19
Lubricants and waste	.16	.05
Supplies	.16	.16
Engine house expenses	2.18	.56
Water	.51	.00
Wages	1.89	.70
Total per million tractive-miles	$29.90	$26.20
Per cent saving	12.5 per cent	

Attention is called to the unit of comparison, "Tractive-Miles," which is the product of the maximum tractive power in pounds and total miles run. This affords a direct comparison.

In explanation of the table given above, it will be noted that the interest and depreciation figure for electric locomotives is much higher than that given for steam. This is because all of the electric cost has been charged against the number of engines in the service, i. e., each engine carries its share of power house transmission, distribution, etc. The actual electrification installation costs have been increased in this table over 100 per cent to adjust the values to those prevailing in 1919.

The cost of electric locomotive repairs has been reduced below the actual figures in order to eliminate charges which have been due to the development of a new design. In other words, the electric locomotives now in service have been experimental, and could they be replaced today by new equipment it is entirely reasonable to expect the figures shown for repairs would be representative. In this connection it is pointed out that the power house, substations and transmission lines gen-

erally are designed for considerably larger service than is now given.

Conservation of Fuel and Saving in Wages

An important question today in connection with the general movement towards conservation of fuel is how much actual fuel can be saved by electric operation, and in this connection the Norfolk & Western has found that with the modern Mallet, compound superheating steam locomotive, equipped with all improvements excepting feed-water heater, about 5.4 lb. of fuel are required per drawbar hp. hour, taking into account road conditions and allowing for standby losses. It should be noted that these figures assume the engine to be in thoroughly good operating condition. With electric operation, about 3.3 lb. of fuel are required per drawbar hp. hour in the present electric service, which gives a direct saving in the fuel bill of about 40 per cent. This amounts to a total saving for the present "Elkhorn Grade" electrification of about 60,000 tons of fuel coal per year. Applying the same ratio of saving to the entire Norfolk & Western system, it is estimated that with complete electric operation the net saving in amount of fuel used would be nearly one million tons per year.

In the case of crew wages, it will be noted that on the "tractive-mile" basis the saving in crew wages is over 60 per cent. A comparison on another basis can be made by comparing the round trip times. The average round trip time for an electric crew between Bluefield and the coalfield is somewhat under seven hours, whereas the best average time under steam conditions formerly was somewhat over 12 hours. Therefore, to make a direct comparison, the seven crew hours in electric operation should be compared with 14 hours in steam operation, taking into account punitive overtime. This in itself would show a saving of 50 per cent in the crew cost, but as there is of course a certain amount of overtime made by electric crews, the net saving is between 35 and 40 per cent.

One important point is that with the present facilities and volume of traffic, it is problematical whether the tonnage could be moved at all with steam. The only possible way to do so would be to increase the number of engines per train so that a schedule speed could be maintained equal to the present electric speeds. This would require probably four Mallet steam engines per train as compared with the two electrics on the heaviest grades, which would increase the operation costs much beyond those shown in the table, and if the percentage of engine failures were at all unusual, the service would be unreliable.

Mileage of Electric Locomotives, Etc.

The total electric locomotive mileage made for the six months ending June, 1920, was 224,974, or an average of 34,162 per month. The average number of locomotives in service per day is about eight, which establishes an average figure of 135 miles per locomotive per day. The company's records show that the kilowatt hours at the power house per locomotive mile are about 160, while the watt hours per trailing 1,000 ton-miles are about 165.

The Application of the Electrification of the Norfolk & Western to Other Railways

In a general way the following statements can be made regarding the utilization of electrical energy for the operation of other railways similarly situated:

(1) That 44,000-volts, single-phase, 25-cycle transmission of electric power with 11,000 volts, single phase on the trolley wire are practical and reliable voltages for electric train service for heavy grades and heavy tonnage.

(2) The average daily gross tonnage of freight eastbound over the electrified grade on the Norfolk & Western for 1918 was 47,500 tons as compared with 32,000 tons in 1912, an increase of over 50 per cent. The ultimate capacity based on the present installation is stated as 80 per cent over that of 1912.

(3) That such a system of electrification will probably effect a saving of at least 12½ per cent of the total annual expense as compared with steam operation on a railway with similar characteristics.

(4) That the introduction of electric locomotives with electric brakes (regenerative braking) has made possible higher speeds on heavy grades, with greater safety and reliability under all climatic conditions.

Appendix E—Underground Conduit Construction

The committee suggested three new electrical definitions as follows:

Duct or Conduit: A unit length of pipe suitable for use in the construction of runways for electric wires or cables.

Manholes: An opening in a splicing chamber through which a man may enter.

Mandrel: A tool used for aligning and cleaning ducts.

Stone Conduits

One of the large utility companies in the middle west has used for several years "stone conduit," and is now using stone conduit of their own manufacture, with very satisfactory results.

The specifications describe the processes of manufacture and method of installation of stone conduit.

1. Materials. Stone conduit shall be made of limestone screenings which will pass through a screen of ⅛-in. mesh and approved make of Portland cement in the proportion of 4¾ to 1 properly moistened with water and shall be formed by tamping in cylindrical moulds.

2. Dimensions Conduit shall be made in lengths of 5 ft. with ⅝-in. walls and 3½ to 4½-in. round bore.

3. Workmanship. (a) Conduit shall be symmetrical throughout, straight, true, smooth, free from cracks, air holes, uneven surfaces or other imperfections which will injuriously affect it. The ends shall be perpendicular to the bore.

(b) Conduit shall be cured for not less than eight weeks after removal from the mould. For the first six weeks it shall be kept wet by sprinkling and then allowed to dry in the air for at least two weeks.

4. Joints. (a) Conduit when thoroughly cured shall be turned, for a distance of ¾ of an inch on each end, sufficient to secure an exact diameter concentric with the bore, but which shall not reduce the thickness of the wall given in Section 2 by more than one-sixteenth of an inch.

(b) With each conduit there shall be supplied a suitable metal sleeve which will fit tightly over the ends of adjacent conduits to hold them in place and to secure perfect alinement.

5. Short Lengths. Pieces of conduit less than the standard 5 ft. length will be accepted, not to exceed 10 per cent. of the total ordered, provided the ends are cut square, dressed and turned for metal sleeves, but no conduit will be accepted less than 2½ ft. long.

6. Inspection. (a) The railroad may inspect the conduit at any time during the process of manufacture and shall be furnished free of cost the necessary tools and appliances for making such tests as are necessary to determine if the requirements of these specifications have been met.

(b) Conduit offered for inspection shall be factory run from which no conduit of a superior quality has been removed.

(c) The railroad shall be given advance notice of completion of conduit to permit it to arrange for inspection.

7. Tests. Conduits shall permit the passage from end to end of a mandrel 3 ft. long and ⅛-in. less than the nominal diameter of the bore.

(b) Samples of 5 ft. lengths of conduit shall be selected at random and after immersion for 24 hours in air shall show an increase in weight of not more than 9/10 of one per cent.

(c) The presence of cracks shall be determined by sounding each piece with a steel hammer or its approved equivalent. Pieces which fail to give a clear metallic ring shall be considered defective.

(d) Conduit which fails to meet all of the requirements of these specifications shall be rejected.

8. Installation. (a) Conduit line shall be encased in concrete four inches thick on top, three inches on the side and a minimum thickness of four inches for the full width of the trench, except where ledge rock is encountered; in which case the concrete foundation may be omitted and the bottom of the trench leveled with cement mortar. Conduits shall be laid with a minimum separation of one inch both horizontally and vertically and the joints shall be staggered so that the joints of adjacent sections will be separated by at least three inches.

(b) In ending conduits only full lengths shall be used in the lower tier at the entrance to splicing chambers. Short lengths where necessary shall be inserted further out in the section.

(c) Where work is suspended leaving incompleted sections the open ends of the conduits shall be plugged with tapered wood, or other approved plug conforming accurately to the shape of the bore and so formed that it cannot be forced entirely within the opening.

(d) During construction work a mandrel three feet long and ⅛-in. less than the nominal bore shall be drawn through the conduits as they are laid.

(e) In other respects the methods of laying stone conduits shall correspond to the American Railway Engineering Association specifications for fiber conduits.

Appendix G—Standards

Many railroads carry in stock a long list of lamps of various kinds, which involves not only a large amount of storage space and storehouse expense, but likelihood of errors in the proper placing of lamps. The accompanying list has been compiled from data obtained both from railroads and manufacturers, in an effort to obtain a list which should be as short as is consistent with efficiency of operation, taking into account both the illumination efficiency and the life of the lamps. Lamps for signal purposes are not included in the report. More than 80 per cent of the lamps manufactured are rated at 110, 115 and 120 volts; and the intermediate voltages are being eliminated as rapidly as possible. With regard to train lighting circuits, the voltage is standardized at 32 and 64 volts. It should not be a difficult matter to so adjust the train circuits as to obtain an average of these potentials and eliminate all lamps of other voltages. Train lighting circuits of the 60-volt range are rapidly disappearing. With regard to the cab lighting, 33 volts appears to have been recommended by the American Railway Association as standard. The voltage has been standard at 34 volts, but the above recommendation of the A. R. A. will undoubtedly involve a change to 33 volts.

All lamps in the list can be obtained equally readily with clear bulbs, or with frosted or enameled bulbs. For "C" lamps of 100 watts or above, the bulbs, instead of being frosted, should be "bowl enameled." The "C" lamps are filled with an inert gas, such as nitrogen or argon, while in the "B" lamps the filament operates in a high vacuum. The diameter of the lamp bulb is measured in eighths of an inch, the shape is indicated by the following letters: S—straight side; G—round (globular), and P. S.—pear shape.

It is realized that the list is not complete, and that probably most railroads will have local requirements which are not met by the list. It is the thought, however, that if the demand can be concentrated on this comparatively small number of sizes and styles of lamps, deliveries will be facilitated, the labor of handling reduced, and manufacturing economies will before long be reflected in prices.

Tungsten Lamp Standards—1920

ILLUMINATION

Size in Watts	*Voltages*	*Type and Size of Bulb*	*Base Type*			*Remarks*
10	110, 115, 120, 125	S. 14	Med.	Screw	B	
15	" " " "	S. 17	"	"	B	
25	" " " "	S. 17	"	"	B	
50	" " " "	S. 19	"	"	B	
75	" " " "	P. S. 22	"	"	C	
100	" " " "	P. S. 25	"	"	C	
150	" " " "	P. S. 25	"	"	C	
200	" " " "	P. S. 30	"	"	C	
250	" " " "	G. 30	"	"	C	Used for flood lighting. Concentrated filament for focusing.
300	" " " "	P. S. 35	Mogul		C	
500	" " " "	G. 40	"		C	do
500	" " " "	P. S. 40	"		C	
750	" " " "	P. S. 52	"		C	
1000	" " " "	P. S. 52	"		C	
25	220, 230, 240, 250	S. 19	Med.	Screw	B	
50	" " " "	S. 19	"	"	B	
100	" " " "	S. 30	"	"	B	
200	" " " "	P. S. 30	"	"	C	
300	" " " "	P. S. 35	Mogul		C	
500	" " " "	P. S. 40	"		C	
1000	" " " "	P. S. 52	"		C	

MILL TYPE

25	110, 115, 120, 125	S. 19	Med.	Screw	B	
50	" " " "	S. 19	"	"	B	

CAR AXLE LIGHTING

15	32-64	(*) S. 17 G. 18½	"	"	B	
25	" "	(*) S. 17 G. 18½	"	"	B	
50	" "	(*) S. 19 G. 30	"	"	B	
25	" "	P. S. 20	"	"	C	Will be standardized to replace the type B lamp at a future time.
50	" "	P. S. 20	"	"	C	"White" bulb may also be used.
75	" "	P. S. 22	"	"	C	
100	" "	P. S. 25	"	"	C	

MOTOR AND TRAILER CAR AND LOCOMOTIVE LIGHTING AND HEADLIGHTS

15	33	S. 17	Med.	Screw	B	Cab Lighting.
23	110, 115, 120, 125, 130	S. 17	"	"	B	Series.
36	" " " " "	S. 19	"	"	B	"
56	" " " " "	S. 21	"	"	B	"
94	" " " " "	S. 24½	"	"	B	"
100	32	G. 25	"	"	C	Headlight.
250	32	G. 30	"	"	C	"

Discussion

E. B. Katte (Chairman): The first sub-committee report is that on electrolysis and insulation, presented as Appendix A.

(Chairman Katte briefly abstracted Appendix A.)

Chairman Katte: In the absence of G. W. Kittredge, chairman of the sub-committee on Water Power, the report will be presented by W. L. Morse, vice-chairman.

(Mr. Morse abstracted the report.)

Chairman Katte: In Appendix C is given Specifications for Insulated Wires and Cables. I have not had an opportunity to talk with Mr. Elliott. I think perhaps I might have made clear the intent of these specifications a little more fully. They were not written to supersede the signal specifications, and there is nothing in this specification which supersedes or takes the place of any of the signal specifications. We hope in the course of a few years, or maybe months, we will have one specification that is applicable to all the various users of electric insulated wire. There will undoubtedly be clauses added to this specification from time to time, in which will be included the special kind of insulation required by the signal department or any of the other departments. The committee which made the tests in connection with the Results of Analysis was made up of representatives of four or five railroads, the U. S. Navy, the U. S. War Department and four or five manufacturers, and after years of research they have finally agreed on a procedure which is fairly accurate. *I move that the railroad specifications for electric wires and cables be approved and printed in the Manual for recommended practice.*

(*Motion carried.*)

Chairman Katte: The next subject is "Underground Conduit Construction, Appendix E," and I will ask Mr. Brumley, chairman of the sub-committee, to present that matter.

(Mr. Brumley then abstracted Appendix E.)

Chairman Katte: The committee recommends for in-

clusion in the Manual the additional electrical definitions, "Duct or conduit, Manhole and Mandrel." *I present that as a motion.*

(*Motion carried.*)

Chairman Katte: I inadvertently passed Appendix D, on electrical interference. The committee recommends that the report be accepted for information, published in the proceedings and the subject continued.

(*Motion carried.*)

Chairman Katte: *I would move that the railroad specifications for incandescent lamps in Appendix G be approved and printed in the Manual.*

(*Motion carried.*)

Chairman Katte: The committee now recommends that the railroad specification for underground conduit construction for power cables, Appendix E, be approved and printed in the Manual. *I so move.*

(*Motion carried.*)

(The committee was dismissed with the thanks of the Association.)

Report on Signals and Interlocking

An investigation of means whereby temporary protection may be provided for track workers or for dangerous track conditions in automatic signal territory is a matter occupying the attention of this committee. Arrangements may be made whereby protection of a temporary or of a permanent nature may be provided. Temporary protection is afforded by signalmen disconnecting signal circuits while permanent arrangements may be made by introducing knife switches or circuit controllers in the circuits. The committee also reported on automatic train control and on the proper time interval for the release of electrical and mechanical devices.

W. J. Eck
Chairman

W. J. Eck is completing his first year as chairman of the committee, although he had been vice-chairman for the four years previous, prior to which time he has served as a member since 1911. He entered the signal department of the Chicago & North Western in 1902 and was assistant engineer from November of that year until July, 1907, when he went to the Southern as signal and electrical superintendent, in which capacity he is now engaged. Mr. Eck has taken an active part in the development of signal and electrical standards and practices, being one of the pioneers in the introduction of alternating current signals in this country.

THE COMMITTEE SUBMITTED a number of revisions for the Manual in Appendix A. The recommendations cover the reprinting of certain parts and the elimination and substitution of other matter in connection with requisites of switch indicators, signal symbols, drawings and specifications, etc.

In Appendix B the committee submitted extracts as information from the report of the Automatic Train Control Committee of the United States Railroad administration to the director general on November 29, 1919.

In Appendix C the committee submitted the results of its study on the subject of methods for the display of signals for the protection of track workers. Its recommendations are given under the heading of Conclusions.

In Appendix D the committee submitted the results of its study on the proper time interval for releases applied to signal or switch apparatus. Its recommendations are given under the heading of Conclusions.

Conclusions

The committee recommended that the following action be taken on the reports submitted:

1. That the changes in the Manual in Appendix A be approved and the revised matter be substituted for the present recommendations in the Manual.

2. That the matter shown in Appendix B be accepted as information.

3. That the following be approved and published in the Manual on the subject of methods for display of signals for protection of track workers:

(1) If temporary protection by signal is desired for track workers or for dangerous track conditions it should be provided by disconnecting the signal circuits so that the proper indication will be displayed. Disconnections should be made by signal forces.

(2) If permanent arrangements are desired for protection, by signal, of track workers or for dangerous track conditions, this may be provided by:

(a) Opening track relay through knife switch.
(b) Opening circuit wires through circuit controllers.
(c) Shunting track by circuit controller or knife switch.

(3) Information may be provided by means of indicators to advise track workers of the approach of trains.

Note.—On an emergency a shunt wire with clips to attach to bond wires may be used, provided prompt action is taken thereafter to arrange for proper disconnection as prescribed.

4. That the following be approved and published in the Manual on the subject of time releases applied to signal or switch apparatus:

For average conditions the proper time interval for the release of electrical and mechanical devices applied to signal and switch apparatus should be the time required for a train running 30 mi. per hr. to travel from a point 1,000 ft. before reaching the distant signal to a point 10 ft. beyond the home signal.

In interpreting and applying this recommendation, it should be distinctly understood that it is only a guide and that the particular local conditions must, in the final analysis, govern the determination of this time interval.

Appendix C—Display of Signals for Protection of Track Workers

It is not recommended that temporary protection by signal shall be provided by means of short circuiting track circuits because of the unreliability of such protection. Even when substantial connections are provided, they are so easily torn loose that no absolute protection is afforded.

If temporary protection by signal for track workers or against some emergency trouble is desired, it should be provided by having the signal forces disconnect the

signal circuits so that the signal will display the desired indication. After the necessity for protection has ceased, the circuits should again be connected by signal forces.

Where it is desired to install permanent arrangements for providing protection for other than purely train operations, any of the following methods, which are now in use on several railroads, seem to take care of the situation:

(a) Open track relay connections at the relay.

(b) Open track relay connection by knife switch.

(c) Open signal circuit wires by knife switch or provide convenient way to cut wires with pliers.

(d) Shunt track by circuit controller operated by switch stand.

(e) Double shunt and break track circuit by knife switch.

(f) Shunt track circuit by circuit controller operated by hand.

(g) Control line circuits by staff instruments operated by track or other maintenance of way forces.

(h) Special indicators to give information of the approach of trains.

Appendix D—Time Releases Applied to Signal or Switch Apparatus

In considering this question, the important and determining factor is that of "Safety." All electric locking devices are applied to promote safety in operation and in considering any device for nullifying such features, safe operation must still remain the principal consideration.

It is obvious that with a given train, the proper time interval for the release of electric locking devices should be the time required for such a train to travel from the point of clear vision of the distant signal (or sighting distance) to a point just in advance of the track circuit controlling the derails or switches.

There is difficulty in formulating any one rule that will govern all the various classes of traffic operating over any one interlocking plant. As either the speed or weight or both of trains increases, the longer should be the sighting distance and the longer the distant signal block. The question then really resolves itself into determining the speed of traffic upon which the recommended rule should be based.

The committee does not recommend that this should be based upon the speed of the slowest train operating over the plant, for the reason that this train can stop in a lesser distance than other traffic.

For average conditions, it is recommended that a speed of 30 mi. per hr. and a sighting distance of 1,000 ft. be assumed.

Upon these assumptions the rule will take the following form:

"For average conditions the proper time interval for the release of electrical and mechanical devices applied to signal and switch apparatus should be the time required for a train running 30 mi. per hr. to travel from a point 1,000 ft. before reaching the distant signal to a point 10 ft. beyond the home signal."

In interpreting and applying this recommendation, it should be distinctly understood that it is only a guide and that the particular local conditions must, in the final analysis, nearly always govern the determination of this time interval.

Committee: W. J. Eck (Southern), chairman; W. M. Vandersluis (I. C.), vice-chairman; Azel Ames (Cons. Sig. Engr.), H. S. Balliet (N. Y. C.), A. M. Burt (N. P.), C. E. Denney (N. Y. C. & St. L.), F. L. Dodgson (G. R. S. Co.), W. H. Elliott (N. Y. C.), G. E. Ellis (A. R.), J. G. M. Leisenring (I. T. S.), H. K. Lowry (C. R. I. & P.), J. C. Mock (M. C.), F. P. Patenall (B. & O.), J. A. Peabody (C. & N. W.), A. H. Rudd (Penna.), A. G. Shaver (Cons. Sig. Eng.), T. S. Stevens (A. T. & S. F.), B. Wheelwright (G. T.), E. E. Worthing (Sou. Pac. Atl. Sys.).

Discussion

W. J. Eck (chairman): The Committee on Signals and Interlocking is reporting on the revision of the Manual, on automatic train control, on methods of displaying signals for the protection of track workers, and on time releases applied to signal or switch apparatus. As to the revision of the Manual, *I move that the changes in the Manual, Appendix A, be approved and the revised matter be substituted for the present recommendation in the Manual.*

(*Motion carried.*)

Chairman Eck: In outlining the method of automatic train control, the committee submits certain data as Appendix B. *I move that the matter shown be received as information.*

(*Motion carried.*)

Chairman Eck: The committee submits a report for the display of signals for the protection of track workers, and recommends that the conclusions be approved and published in the Manual. *I make a motion that the same be adopted.*

(*Motion carried.*)

Chairman Eck: Under time releases, as applied to signal or switch apparatus, *I move that the conclusion be approved and published in the Manual.*

The Chairman: Is the last paragraph under Appendix D to be incorporated in the Manual?

Chairman Eck: Yes.

The Chairman: Do I understand that the entire text of Appendix D is to be incorporated in the Manual?

Chairman Eck: No, sir. I moved that the conclusion be approved.

G. A. Mountain (Kan. Ry. Com.): What regulates the speed of 30 miles?

Chairman Eck: It was taken as an average figure. For average conditions a rule or section of this sort must be carefully considered, as we bring out in the last paragraph.

(*Motion carried.*)

(The committee was dismissed with the thanks of the Association.)

Permanency and Harmony of Design Are Well Illustrated in the Lackawanna Tower at Montclair, N. J.

Report of the Committee on Rail

The rail record forms have been revised and renumbered to divide them into groups relating to inspection and shipment, rail failures and rail wear. The relation of shattered steel in fissured rails to the mill end of the rail was discussed by M. H. Wickhorst, who concluded that this shattering developed in the cooling and seems to be shrinkage checks. Dr. P. H. Dudley presented data to show that the broad head of the 100-lb. and 105-lb. rail sections provides ample area to carry the wheel loads of present-day traffic without impairment of its initial ductility with rails made from saund, homogeneous metal. Elimination of brittleness would reduce failures.

G. J. Ray
Chairman

G. J. Ray has been a member of the committee for five years and chairman for three years. He has also been active in other work in the Association, having served as chairman of the Track committee for several years and as a member of the Board of Direction from 1914 to 1917. He has been chief engineer of the Delaware, Lackawanna & Western for 12 years, during which time he has led in the development of an unusually permanent form of track construction employing treated ties, screw spikes and heavy ties plates and fastenings. He has long been a student of the rail problem and has had an important part in measures for improvement.

THE COMMITTEE GAVE CONSIDERABLE attention to the rail record forms in the Manual, and in Appendix A presented forms recommended for inclusion in the Manual to replace the present forms.

During the year special reports were presented by the Rail committee as follows:

No. 89. Fail Failure Statistics for 1918 Classified by Railroads, by M. H. Wickhorst.

No. 90. The Relation of Shattered Steel in Fissured Rails to the Mill End of the Rail, by M. H. Wickhorst.

No. 91. Fail Failure Statistics for 1919, by M. H. Wickhorst.

No. 92. Residual Ductility Tests in the Bearing Surface from Failed Rails in Service, by Dr. P. H. Dudley.

Report No. 90 is a continuation of the research work to discover the cause of interior rail shattering so a remedy can be provided. Previous reports by the Rail committee have announced the discovery of a shattered condition in the interior of the heads of rails that had failed from transverse fissures; that is, the interior steel contained numerous small cracks, some of which developed in service and some of these in turn finally breaking the rail. It has already been shown that in the body of the rail the shattering remains about one-half inch away from the exterior surface and this investigation shows that the shattered interior also terminates about one-half inch short of the end of the rail as hot-sawed at the mill. This indicates that the shattering was not in the hot rail bar as rolled, but developed in the cooling of the rail; that is, the small cracks are probably shrinkage checks.

Dr. Dudley's paper describes the results of drop tests of 65 rails which had failed in service. They were cut into short lengths and tested in the drop test with the head in tension, to determine their ductility. Most of the rails were lacking in ductility, but some showed good ductility. Failures of the coalescent type occurred mostly in the A rails, while failures of the intergranular type were more numerous in the B and C rails.

Conclusion

The committee submitted the following resolution for adoption by the Association:

That the rail record forms submitted with this report (Appendix A) be adopted by the Association and included in the Manual to replace the present forms.

Committee: G. J. Ray (D. L. & W.), chairman; H. B. MacFarland (A. T. & S. F.), vice-chairman; E. E. Adams (U. P.), A. S. Baldwin (I. C.), W. C. Barnes (U. P.), W. C. Cushing (P. R. R.), G. M. Davidson (C. & N. W.), Dr. P. H. Dudley (N. Y. C.), J. M. R. Fairbairn (C. P. R.), L. C. Fritch (C. R. I. & P.), J. H. Gibboney (N. & W.), A. W. Gibbs (P. R. R.), C. R. Harding (S. P.), John D. Isaacs (S. P.), H. D. Knecht (M. P.), Howard G. Kelley (G. T.), R. Montfort (L. & N.), A. W. Newton (C. B. & Q.), J. R. Onderdonk (B. & O.), F. S. Stevens (P. & R.), F. M. Waring (P. R. R.), M. H. Wickhorst, J. B. Young (P. & R.).

The Relation of Shattered Steel in Fissured Rails

Rails that have failed in track due to interior transverse fissures contain "shattered" steel in the interior of the rail head, as disclosed by deep etching with strong hydrochloric acid of sections of the rail head, particularly horizontal longitudinal sections through the middle of the head. Etchings have shown the cracks to be deeply imbedded in the rail head, occurring not less than about one-half inch from an external surface. This suggested that the cracks are shrinkage cracks formed during or after the cooling after the rail bar has been fully formed. If so, then the end of the rail produced in the sawing of the hot bar also should be free from the cracks for about one-half inch or so from the end as hot sawed.

About 25 fissured rails were examined, and as a part of the investigation of the rails, longitudinal sections through the interior of the head, six inches long, were cut from each end of the rail and from near its middle. Most of the samples showed a defective condition in the interior of the head and about half the rails showed a condition of badly shattered steel, displaying numerous etching cracks. The samples which showed numerous etching cracks were suitable for observations as to whether the zone of shattered steel terminates before reaching the end of the rail and measurements were therefore made on these rails, of the distance from the end of the rail to the nearest crack displayed in the etched section. The numbers of the rails on which the measurements were made and the mill and service data concerning the rails were compiled. The results of the measurements showed that the shattered steel terminated from 0.33 to 0.62 inch from the end of the rail, with an average distance of 0.49 inch in the 19 rail ends measured. At any other place on the etched surface, including the end of the slab cut six inches from the mill end of the rail, a line drawn at right angles across the surface from side to side would be apt to cut through a crack or come close to it. This fact and the angular nature of the small cracks indicate that the shattering was not present in the hot bar as it left the finishing rolls, but developed in the cooling; that is, the cracks seem to be shrinkage checks. On the other hand, it has been sug-

gested that the freedom of the end of the rail from cracks is due to the densifying effects of the hot saw, and not to the relief of the end from strains.

Residual Ductility Tests

For several years the New York Central Lines have conducted numerous drop tests on rails removed from service after having developed interior transverse fissures. These tests were conducted principally under an improvised drop testing machine, so constructed that the full residual ductility could not be developed. During July, 1920, a standard drop testing machine was used, so that each individual piece could be tested to destruction, and the full residual ductility developed. Rails were gathered from widely scattered locations, and represent failures in melts rolled in different years, as well as different months of the same year.

The tests were all made with the head in tension, supports 3-ft. centers, and the 2,000-lb. tup falling through a height of 15 ft. The object in testing all pieces of the old rails with head in tension was to determine the amount of residual ductility in the cold rolled bearing surface, and also to classify the type of head fracture as each piece was broken under successive drops.

Of the 305 pieces tested, 137 broke on the first blow without displaying ductility. One hundred and fifty-eight, or 52 per cent of the total tested, developed at least five per cent in two consecutive inches; the residual ductility on the various test pieces ranging all the way from 5 to 19 per cent, the latter amount being obtained in one inch of one test piece. This is a remarkable showing in view of the service records of these rails under severe traffic, speed and weather conditions, and substantiates the fact that the broad head of the 100 and 105-lb. rail sections provides ample area to carry the wheel loads of present-day traffic, without impairment of its initial ductility, when the rails are made from sound, homogeneous metal, both physically and chemically.

It should be noted that of the 137 test pieces failing under the first blow of the tup, 57 disclosed cores, or fissures of either the coalescent or intergranular type. Over half of the remaining 80 pieces were portions of high and low rails from curves. These contained the accumulated deformation and abrasive effect from the impingement of thousands of wheels, of which a great many were cast iron wheels with the M. C. B. contour. The chamfer of the cast iron wheels on the low rails does more than simply abrade the bearing surface. The action seems to exhaust the ductility in a faster ratio than the ordinary rolling abrasion. The metal in the low rails wears hollow, and in portions of the bearing surface the metal is frayed and ragged. It could hardly be expected under the 30,000 foot-pounds of the drop that this frayed metal would show as much ductility as on rails where only rolling abrasion has occurred.

It was exceedingly important to find the high residual ductility in such a large number of the test pieces from these rails after 5 years, or more, of service. The statement has often been made and inferred that the ductility is practically nil in all rail heads after relatively lighter traffic conditions and shorter lengths of service than was obtained on this lot of rails. This supposition will need revision from a study of the tests included in this report, for the evidence presented shows that a large amount of ductility still remains in many of the pieces of the old rails, with the full ductility due to the chemical composition, after a number of years' service.

Discussion

(In the absence of both the chairman and the vice-chairman the report was presented by J. M. R. Fairbairn [C. P. R.]).

Chairman Fairbairn: Our chairman has written a letter in presentation of this report which I think it is in order to read, as I think it is the unanimous feeling of the committee on this subject. Mr. Ray says:

So far as the committee is aware no rail has been rolled under the new specification. This is not at all surprising considering the attitude of the manufacturers. On September 14, 1920, the rail committee met with the rail committee of the manufacturers. All phases of the specifications were freely discussed. The manufacturers, as represented by their rail committee, have stated that they will not agree to roll rail of any weight under a contract requiring full compliance with all features of the 1920 specifications. They have stated that they will roll rail up to 110 lb. per yd. under the 1920 specifications slightly modified so as to eliminate a few of the so-called objectionable paragraphs on manufacture or mill practice. This modified specification will take an extra price estimated at approximately $13.00 per ton for a base price of $57.00, or something in excess of $9.00 on a base price of $47.00. The manufacturers' committee have further stated that they will not meet the 1920 specifications at all for rail 111 lb. per yd. and over. The big extra demanded by the manufacturers has practically killed the new specification. Naturally, no railroad management will pay so large an extra for a standard specification until it has been proven beyond a doubt that rail manufactured under such specifications is sufficiently superior to warrant the extra price.

The rail committee is at present somewhat confused as to what to do under the prevailing conditions. Those reasonably well satisfied with the quality of rail now being received are opposed to changing the specifications if by so doing the price of rail will be increased. They are also opposed to two standard specifications, one for a higher quality of rail to require an extra price. Naturally they do not wish to be placed in the position of purchasing an inferior brand of rail. With the present attitude of the rail manufacturers there is little that can be done by the rail committee to improve the 1915 specifications without creating extra expense on the part of the purchaser.

It is a fact that many of the mills are rolling rail under modified specifications and the rail manufacturers freely admit that they are willing to roll rail for individual roads under specifications containing many of the objectionable features of the 1920 specifications. Some such specifications take a slight extra, in other cases no extra is charged. The rail committee has sought a reason from the manufacturers for their willingness to roll rail without extra charge under private specifications when they are not willing to have the special features of the private specifications included in the A. R. E. A. specifications. In answer the manufacturers give what appears to be a more or less reasonable explanation. Where the manufacturers and the individual road agree on a special specification, consideration is given to all features of the specification and the method of inspection together with the judgment and fairness of the inspector, or those responsible for the inspection. Where both the physical and chemical properties of the finished rail are limited as in the A. R. E. A. 1920 specifications, a strict compliance with the specifications as to chemistry might be the cause of discarding more or less perfectly good rail, but where the railroad officials are inclined to be fair and reasonable, some of the manufacturers are willing to try out the specifications, although such specifications may vary materially from the standard. They are not willing to take chances with inspectors at large and claim that the general use of such a specification as the A. R. E. A. 1920 would cost the manufacturers a

material amount of money, and in their opinion such refinement is not needed with the greater portion of the tonnage used throughout the country.

There is undoubtedly some merit to the manufacturer's contention that the purchaser should not specify the method of manufacture and also place a limit on both the chemical and physical requirements of the finished rail. On the other hand, the consumer is anxious to have sufficient control over the mill practice and to place such limits on the physical and chemical properties of the finished rail as to insure the elimination of both the dangerous and poor wearing rail.

The rail committee will endeavor to reach a conclusion during the coming year. First: Should the Association adopt two specifications, one to be the best possible without running into extra price; the other to be the 1920 specification, possibly revised, but requiring an extra price? Second: Should we have one specification without extra cost over the manufacturer's base price, the Association to be given a list of specific refinements in the order of their importance (considering the probable cost) so that roads requiring a higher grade of rail will have the benefit of the Association's judgment on the most valuable of such refinements?

Chairman Fairbairn: I think Mr. Ray has so thoroughly covered the ground in presenting the report, there is really nothing further to be said on the subject, except to proceed with the report itself. I will ask Mr. Newton, chairman of the sub-committee, to present the part of the report referring to Revision of the Manual.

A. W. Newton (C. B. & Q.): After a meeting of the committee the conclusion was reached that we should revise the forms in the Manual covering the production of rail and the records of rail failures and rail wear in track.

In order to ascertain the feeling of the railroads respecting the use of these forms, a circular letter was sent out and replies were received from 49 different roads, which showed that on the roads reporting only two of the forms are generally used. One was the failed rail report as it is commonly known, and the other is the summarization of those reports that is submitted annually to the rail committee.

Of the other, I think, 15 forms, out of 49 roads it appeared that about only 4 or 5 of the roads were using this or that or the other form. Only one or two roads made any attempt to use the number of the forms as provided.

One thing that the committee wishes brought to the attention of the convention is that probably much more valuable information would be available if all the roads interested would take a more active part in the compilation of data on this subject, not only the manufacture of rails, but of the results obtained from rails in the past. The changes made were such as would make it possible to give a little more detail in some respects and make it possible to apply the specifications of 1920 to record the results of any rail production under those specifications.

Chairman Fairbairn: *I move that the Association adopt these forms for inclusion in the Manual to replace the present forms.*

C. E. Lindsay (N. Y. C.): In the report to be used by the section foreman the committee shows the gage side in plan or elevation, but do not provide for showing it in the section.

The Chairman: The committee states that that suggestion will be incorporated in the drawing.

C. W. Baldridge (A, T, & S. F.): In checking over the rail failure reports in the form Report of Rail Failure in Main Track I found that the term "Rail Section" gave the section foreman more trouble than most of the other matters in it, and I prepared a form for our own road, some two or three years ago, in which we propose to overcome this by a little note to the foreman saying—"Show once on this line all letters and figures appearing in raised form on the rail."

Mr. Newton: That subject was considered, and I think it has been tried by other roads than your road. We tried it once, and when the report came in it happened that there were four sets of numbers on the rail that failed, and he started at one end and went clear to the other end, and we got all the figures. The committee in giving study to that, felt that the roadmaster who has to prepare these reports should certainly be conversant enough with the subject to have proper reports made by the section foreman.

Mr. Baldridge: I realize that a good many foremen, if you simply leave it to them to show the brand without any instructions, or the heat number without any instructions, would repeat it, but by putting the note—"show *once* all letters and figures appearing in raised form in the rail" I think he would get a pretty accurate brand.

I have this to say in regard to the checking up of these reports by the roadmasters—fully 50 per cent of these reports come in without the roadmaster seeing them. The clerk checks them up.

A. L. Davis (I. C.): On the Illinois Central we tried the same plan about two years ago, cutting out a lot of questions and substituting one line across the top of the form. We found it does not work out at all, but that by having the separate questions, as the committee has recommended, we get better results.

E. A. Frink (S. A. L.): It is obvious that this form is the most important form we have for our rail data, because upon it is based all the information we get as to the actual failure of the rail in the track. There is one class of failures which is unfortunately becoming more prevalent in our track and that is transverse fissures. I find that many of our section foremen (and I presume other roads have had the same experience) have not been educated to distinguish a transverse fissure, at any rate, not in all cases. I think this form would be improved if a note was inserted where rail failures are classified, bringing out the fact that a transverse fissure before it penetrates to the edge of the rail is always white, and after it reaches the outside air is almost invariably black or dark in color. If you bring that out more strongly a foreman will be more apt to report these breaks correctly.

J. L. Campbell (E. P. & S. W.): I believe a good plan in this connection would be if a railroad company would provide the foreman with a photograph of a typical transverse fissure, and that will give him a physical illustration of what it looks like. It is not difficult to photograph this particular form of failure so that it shows clearly, and that can be transferred to the blue print, where it can be shown clearly.

Chairman Fairbairn: On the Canadian Pacific we have inserted in our maintenance of way rule book a few pages on the subject of rail failures. They are really instructions to section foremen and roadmasters as to the use of these forms. They illustrate and elucidate what is required for each of these numbers. We give further, an illustration by photographs of what a transverse fissure is, and we try to educate the foreman to such an extent that he can intelligently fill in these forms, and I believe if that system of advising the trackmen was generally practiced the form as it now exists is in about as good shape as it can be put.

(*The motion was put to vote and carried.*)

Chairman Fairbairn: The next subject is a report on rail failures, comprising present statistics and conclusions

as to causes and including suggestions for improvements in rail steel.

Mr. Wickhorst will present that part of the report.

M. H. Wickhorst: I am asked to talk on the subjects, rail failures and investigations. I might just dispose of one of these, the subject of investigations, hurriedly, by calling your attention to the work, particularly along the line of transverse fissures—the work of the last few years, and which has been continued during the last year, has shown that fissures occur in steel that has been shattered interiorly, that is, the interior of the head contains numerous small cracks which are apparently in the rail at the time it is put into the track. At any rate there is a potential condition and a fissure is a development of some of the small cracks originally in the rail.

The paper on The Relation of Shattered Steel in Fissured Rails to the Mill End of the Rail, shows this, but I may say, first, that this shattered condition does not extend to the surface, either at the top or the side, but remains about a half inch away, and this particular investigation shows that that shattered condition does not extend clear to the end of the rail as it was not sawed. It terminates about a half inch away from the end, in other words, it is a purely interior condition.

Doctor Dudley has also presented the results of some of his work—tests of a great many rails that have failed from fissures, and tests particularly by means of drop testing, and we have some very interesting information. One is these fissures of the type that are called the coalescent type, that is, where there is a horizontal fissure extending lengthwise of the rail and horizontal, perhaps ½ to ¾ in. That type of fissure occurs largely in the A-rail. Its point of origin or point of growth is from a streak in the interior, apparently in most cases a streak of slag, or some other non-metallic inclusions.

The type of transverse fissure—pure and simple transverse fissure—that has no longitudinal element to it, occurs mostly in the D and C rail. This zone includes perhaps 25 to 40 per cent of the ingots, which takes most of the fissures of that type. It is very interesting to know how that is caused, but we have not worked that out.

A study of rail failure records indicates that it is probable that a further reduction of perhaps 80 per cent can be made, and we have that to look to as a goal for the next eight or ten years perhaps.

Some years ago, when the thin base sections were used largely, there were a large number of failures of the base, but that type of break has been largely overcome by thickening of the base. I would suggest to those roads that are still using these thin bases, where the rails are in heavy service, would profit by adopting some sections with the heavy base.

The specifications should be so designed that the ductility of the metal in the rail can be retained. The mill practice, the methods of manufacture, should be such as to eliminate such matters as segregation in the ingot, inclusion of slag. That means good ingot practice.

The inspector has a very important part. The specifications generally permit the inspector to test the head with either base in tension or with the head in tension. Early work of the rail committee showed that the results when the rail is tested with the head in tension correlate pretty well with the interior condition of the ingot. Segregation of carbon and phosphorus or possibly large amounts of over-inclusion will show up in the analysis of the rail, or in etching tests. This same condition can be shown pretty well by testing the rail with the head in tension. With the base in tension, however, the correlation is not so good.

Tensile tests of rails made from special ingots showed much better than the ordinary type of ingot. But when they made break tests, and these tests were made with the head down, the ordinary type of ingot was quite as good or possibly even a little bit better.

C. W. Gennett, Jr. (C. W. Hunt & Co.): As one who is continually brought into very close contact with the rolling of steel rails, and frequently with their later use, I feel that some observations of the past year's work may be opportune. Production was low, one mill rolling no rails at all, four others contributing only a small tonnage, and the remaining eight of the United States and Canada rolling at a rate much reduced from normal. Such operations do not, in my judgment, speak for the best of quality, for slow operation generally means intermittent rolling, and may easily result in bad quality. As a rule, the best results may be expected when the mills are rolling steadily, with the various details running smoothly and with clocklike precision.

Perhaps the most curious fact apparent at the mills is their loathness to adopt any special means aiming towards the casting of sounder ingots. It is practically agreed that the segregated and physically unsound steel occurring in the top part of the ingots is the direct cause of virtually half of the troubles occurring with rails in service, for split, crushed, flowed and mashed heads are mostly confined to "A" or top rails from ingots. A number of "A" rails constitute, roughly, 15 per cent of all that are rolled and, while they all bear a mark of suspicion, still their price is the same as for the less doubtful rails.

Several mills have recently widened the distance between the supports in the cold straightening presses and as much as 60 in., instead of 42 in., is now being used. Needless to say, the results are favorable and it is to be hoped that the practice will be adopted at all the mills and the punishment of the rails in the damaging process of straightening thus reduced.

A continued source of difficulty at most mills is the inability to make every heat of open hearth steel analyze within the limits of the chemical composition specified for the particular order being worked. Frequently whole heats in the form of ingots or blooms have to be temporarily set aside to be later reheated and rolled on orders which their composition fits. Such cases invariably give rise to an increased number of flawed rails and the practice is manifestly unsatisfactory. Carbon is one of the chief causes of this trouble, and it would be extremely desirable to agree on a common standard to cover the carbon content of all rail steel.

It is difficult to say what specifications for rails are the most commonly used. Definite figures would probably show that the Manufacturers' Standard had been used on the largest tonnage, and following them would come the A. R. E. A. of 1915, often with modifications making it virtually that of the A. S. T. M. and, finally, several others of the individual railroads. Practically all of these specifications contain the clause governing ductility, which requires that the drop test pieces show at least five per cent elongation in two inches or six per cent in one inch.

The question of interior defects showing at the drop test is important. The rejections at one mill, due to interior defects, were approximately 10 times those at another. Such a diversity of results, of course, indicates a diversity of practice, and naturally raises again not only the question of making sound ingots, but also the desirability of treating each ingot as a unit and testing it accordingly, as was repeatedly done in war times with shell steel and is easily accomplished at the Canadian mills on rails for that country.

I venture the statement that good steel cast into sound ingots, of proper composition, followed by careful treatment in the soaking pits and rolling mills, may be expected to result in rails of such quality as to safely withstand, when laid on a roadbed of good ballast and ties, the heavy wheel loads of traffic for years to come.

(The committee was dismissed with the thanks of the Association.)

Report of the Committee on Track

Designs for 5/8 and 9/16-in. cut track spikes are presented. Specifications for switches, frogs, crossings and guard rails with data for laying out frogs are offered. New requisites for switch stands, including connecting rods, are presented. A number of typical plans for turnouts, crossovers, frogs and guard rails were submitted. A theoretical study of gages and flangeways for curved crossings was printed as information. The committee is working on plans and specifications for switch stands, switch lamps and switch locks and also on tie plates, derailers and anti-creepers. Little track work was done by contract, except on a cost-plus plan, last year.

W. P. Wiltsee
Chairman

W. P. Wiltsee has been chairman of the Track committee for three years and a member of the committee for two years more. He has also been active in the work of the Roadmasters' and Maintenance of Way Association, of which organization he is now president. In directing the work of the committee he has been particularly successful in enlisting the co-operation of the Manganese Track Society in the development of standard plans for special track work and in harmonizing conflicting opinions regarding these standards. Mr. Wiltsee is principal assistant engineer of the Norfolk & Western, in which capacity he has a wide range of duties.

In Appendix A the committee presented a large number of proposed changes in the Manual.

In Appendix B the committee reported on typical plans of turnouts, crossovers, slip switches, double crossovers and railroads crossings, and detail plans for such work, including necessary fixtures, etc., and its recommendations are given under the conclusions. In Appendices C, D, E and F the committee submitted progress reports on gages and flangeways for curved crossings; plans and specifications for switch stands, switch lamps and switch locks; plans and specifications for tie plates, derailers and anti-creepers; specifications and piece work schedules for contracting track maintenance work.

The committee also reported progress on: Subject 3, "Reduction of taper of tread of wheel to 1 in 38, and on canting the rail inward"; on Subject 4 (a), "Report on tests of tie plates subject to brine drippings, and (b) on the effect of brine drippings on track appliances;" on Subject 5, "Plans and specifications for track tools," and on Subject 6 ,"Report on limit of wear on frogs, including rules for determining when frogs are sufficiently worn to warrant removal."

Conclusions

1. The committee recommended the changes in the Manual as submitted in Appendix A be approved and the revised matter be substituted for the present subject matter in the Manual.

2. In Appendix B the committee submitted detail plans as per instructions, recommending certain of them for adoption and others to be received as information. These plans are the result of the study and co-operation of your committee and the Frog and Switch Manufacturers of the Manganese Track Society. Appendix B also covers a progress report on uncompleted work, and the committee recommended reassignment of the subject.

2a. In Appendix C a theoretical study was submitted on the subject of gages and flangeways for curved crossings, which the committee recommended be accepted as information, also that the subject be reassigned.

3. The committee reported progress and recommended that subjects Nos. 3, 4, 5 and 6 be reassigned. It also recommended that the progress reports in Appendices D, E and F be accepted as information, and the subjects reassigned.

Committee: W. P. Wiltsee (N. & W.), chairman; J. V. Neubert (N. Y. C.), vice-chairman; L. B. Allen (C. & O.), V. Angerer (Wm. Wharton, Jr., & Co.), W. G. Arn (I. C.), J. D. Baker (P. R. R.), R. A. Baldwin (C. N. R.), G. H. Bremner (I. C. C.), H. G. Clark (C. R. I. & P.), E. A. Hadley (M. P.), G. W. Hegel (C. J.), E. T. Howson (Railway Age), T. T. Irving (G. T.), J. B. Jenkins (B. & O.), H. A. Lloyd (Erie), J. de N. Macomb (A. T. & S. F.), F. H. McGuigan, Jr. (V. S. R. A.), F. L. Nicholson (N. S.); R. M. Pearce (P. & L. E.), H. T. Porter (B. & L. E.), J. H. Reinholdt (M. & St. L.), G. J. Slibeck (Pettibone, Mulliken Co.), J. B. Strong (Ramapo Iron Works), J. R. Watt (L. & N.).

Appendix A—Revision of Manual

The committee recommended that the following changes in the Manual be made:

Cut Track Spike

The committee recommended that the design of the cut track spike shown on page 22 of the 1918 supplement to the Manual be withdrawn, and the designs for 5/8-in. and 9/16-in. cut track spikes submitted be substituted therefor, as the present design in the Manual does not correctly show the slope of the underside of the head of the spike to agree with the slope of the top of the rail base. The design of 5/8-in. cut track spike is the same as that submitted last year and as published in Vol. 21, Bulletin 221, except the width at the toe end has been changed to 5/8 in. instead of 1/2 in., and the curve under the head has been changed for greater strength and better contact of the jaw of a claw bar.

Reports as to the practicability of this design for manufacture in automatic machines have been received from various steel companies and samples have been submitted to this committee.

It was recommended that pages 168 to 186, inclusive, in the Manual be omitted commencing with the article "Crossovers," and the following substituted:

Specifications for Switches, Frogs, Etc.

I. General Instructions

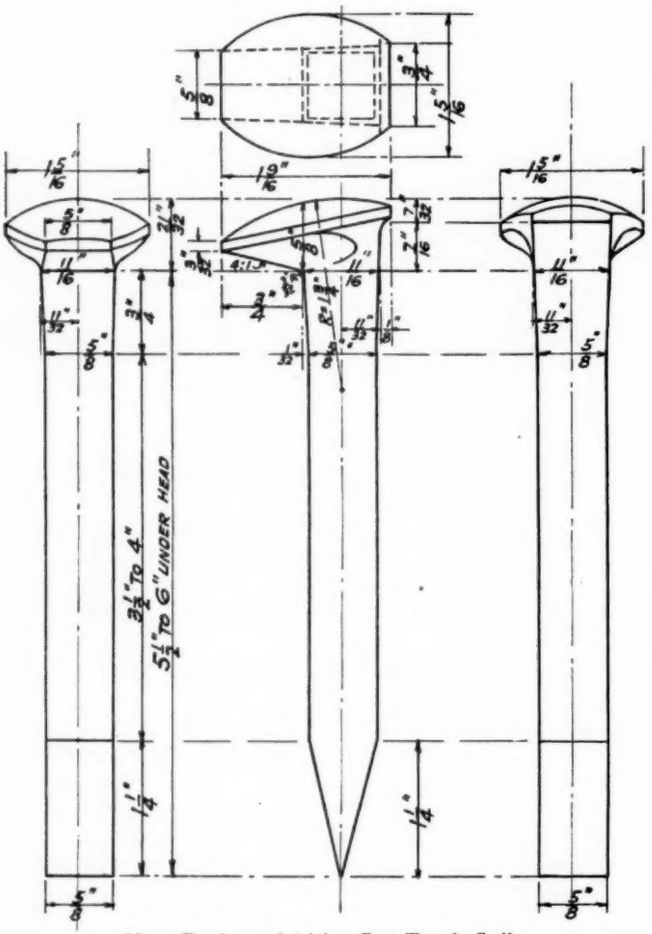
1. The purchaser will furnish the manufacturer specifications and drawings, giving rail sections, splice drilling, angles,

alinement and general dimensions, and such special details as may be required.

2. Unless otherwise specified the construction, design and details shall conform to the plans adopted by the American Railway Engineering Association as recommended practice. For track structures for which no such plans have been adopted, the manufacturer shall, when requested, submit for approval detail drawings.

3. The detailed drawings shall be on sheets 22 in. wide between outside border lines, with inside border lines ½ in. from the top and bottom. The standard length of the sheet shall be 30 in. between outside border lines with inside border lines ½ in. from the right-hand edge and 1½ in. from the left-hand edge. When longer sheets are necessary they shall be in multiples of 6 in. and folded back to the standard length.

Drawings shall be confined to one subject. The title shall be placed in the lower right-hand corner. The scale of the general drawings shall be 1½ in. equals one foot, where practicable. Details not less than 3 in. equals one foot wherever



New Design of ⅝-in. Cut Track Spike

practicable. Dimensions and distances under 2 ft. should be shown in inches; 2 ft. and over in feet and inches. Cross-sections shall be section lined for the material to be indicated in accordance with standard sections as shown in the A. R. E. A. Manual. Manganese steel section to be indicated by heavy single lines.

4. The drawings shall be part of the specifications. Anything that is not shown on the drawings, but which is mentioned in the specifications, or vice versa, or anything not expressly set forth in either, but which is reasonably implied, shall be furnished, the same as if specifically shown and mentioned in both. Should anything be omitted from the drawings or specifications that is necessary for a clear understanding of the work, or should any error appear in either the drawings or specifications affecting the work, the manufacturer shall notify the purchaser and shall not proceed with the work until instructed to do so.

II. Material

5. **Rail.** The rail used shall be first quality open-hearth steel of the section called for, manufactured according to A. R. E. A. specifications or to rail manufacturers' standard specifications, unless otherwise specified.

6. **Gray Iron Castings.** Gray iron castings shall be of a good commercial grade of medium gray iron.

7. **Steel Castings.** Steel castings shall be of good commercial grade manufactured in accordance with standard specifications of the American Society for Testing Materials for steel castings class "B"; except that steel castings exposed to wheel wear shall have a hardness approximately that of rail steel.

8. **Cast Manganese Steel.** The cast manganese steel shall conform to the standard specifications of the Manganese Track Society.

9. **Malleable Iron Castings.** Malleable iron castings shall be of a good commercial grade, properly annealed.

10. **Rolled or Forged Steel.** Rolled or forged steel parts shall be of a medium grade of commercial mild steel. Parts exposed to wheel wear shall be equal in hardness to rail steel.

11. **Fillers.** Fillers shall be of rolled or forged steel, wrought iron or of good quality gray cast iron as called for on plans and as specified.

12. **Heel Risers.** Heel risers shall be as called for on plans and provide wearing surface equal in hardness to rail steel.

13. **Foot Guards.** Metal foot guards as shown on plans shall be of rolled steel or malleable iron. Wooden foot guards shall be good quality hard wood. Filler blocks when acting as foot guards may be of gray iron.

14. **Bolts.** Bolts, other than where heat treated bolts are called for on plans or specified, shall be of mild carbon steel and shall have a tensile strength of not less than 50,000 lb. per sq. in. and an elongation of not less than 15 per cent in 8 in. Heat treated or high tensile bolts shall be of carbon or alloy steel and conform to the following minimum requirements:

Tensile strength	100,000 lb.
Yield point	70,000 lb.
Elongation in 2 in.	15 per cent.
Reduction of area	40 per cent.

Full-size bolts shall bend cold without cracking through 180 deg. around a pin of the same diameter as the bolt. The yield point, elongation, and reduction of area may be determined from a finished bolt or from a test piece ½ in. by 2 in. turned from a finished bolt. Nuts may be Bessemer or open-hearth carbon steel not treated and shall be of sufficient thickness to develop the full strength of the bolt.

15. **Rivets.** Rivets shall be made of steel manufactured in accordance with the standard specifications of the American Society for Testing Materials for rivet steel for ship or structural work.

16. **Reinforcing Bars.** Reinforcing bars shall be of wrought iron or mild open-hearth steel.

17. **Plates.** Switch plates, special frog tie plates, and bearing plates shall be of mild open-hearth steel.

18. **Switch Clips.** Switch clips shall be of mild open-hearth steel, except special designs, which may be of cast steel or malleable iron.

19. **Switch Rods.** Switch rods shall be of mild rolled steel or wrought iron.

20. **Stops and Hold-Downs.** Stops and hold-downs shall be of mild rolled steel or wrought iron.

21. **Anti-Creeping Device.** Anti-creeping devices shall be of mild rolled steel or wrought iron.

22. **Braces.** Braces shall be of mild rolled steel, malleable iron or cast steel.

12. **Washers.** Washers shall be of mild rolled steel, malleable iron or cast steel.

24. **Nut Locks.** Nut locks shall be of good strong spring steel.

25. **Switch Heel Blocks.** Switch heel blocks shall be of gray iron, cast or forged steel as specified.

26. **Springs.** The steel in springs shall conform to the standard specifications of the American Society for Testing Materials for carbon steel bars for railway springs. Springs when forced down solid and held in the compressed position for thirty seconds, upon release, must not vary from their original free length.

27. **Spring Housings.** Spring housings shall be of gray cast iron, malleable iron or cast steel.

28. **Forged Crossing Knees.** Forged crossing knees shall be of mild rolled open-hearth steel or wrought iron.

29. **Special Splice Bars.** Special splice bars shall be of mild rolled steel or cast steel.

III. Workmanship

30. **Workmanship.** Workmanship shall be first-class and in accordance with best current practice. The assembly of the several parts shall be such that uniformity of detail and finish will result.

31. **Alinement and Surface.** The alinement and surface of all finished work shall be even and true and conform to the angles specified.

32. **Length.** Length of frogs and crossing arms shall not vary more than ¼ in. from lengths specified. Switch-point rails and guard rails shall not vary more than ½ in. from length specified. Rail ends shall be cut square to the axis of the rail, unless otherwise required.

33. **Flangeways.** The width of flangeways shall not be less than nor more than 1/16 in. greater than the width specified, when measured on the level of gage line ⅝ in. below tread surface. Flangeways shall not be less than 1⅞ in. deep measured from top of the tread surface, unless otherwise specified.

34. **Bending.** Bends shall be made accurately in arcs of circles and without injury to the material. It is desired that rails be bent cold. If heating of the rails is resorted to it must be done in a manner so as not to injure the metal.

35. **Planing.** All planing must be true and all abutting surfaces must fit accurately.

36. **Grinding.** Running surfaces of the manganese steel parts shall be ground to practically as good a surface as that of the rolled rail. Manganese steel portions fitting into rails or other parts shall be ground to a good fit.

37. **Drilling and Punching.** All holes in carbon steel rails must be drilled. In other parts all holes for turned pins or bolts and for tight fit of rough bolts must be drilled. Drilling to be done accurately, on bevel where necessary. Punching will be permitted only in wrought iron or mild steel parts for rivets, loose rough bolts and spikes, except when such holes come so close together or close to the edge of the piece that the metal between holes or between hole and edge is less in width than the thickness of the material, in which case holes must be drilled.

38. **Fit of Bolts.** Main or body bolts in frogs and crossings shall have a tight fit in straight true holes. Heads and nuts shall have a square bearing. Other bolts not requiring a tight fit, unless otherwise specified shall shall a clearance of not more than 1/16 in. in drilled or punched holes and not more than ⅛ in. in cored holes. Threads must be U. S. Standard, accurately cut within tolerance of best practice for cut threads. Nuts must have a tight fit.

39. **Rivets.** Rivets shall be of full diameter called for on plans and rivet holes shall not be more than 1/16 in. greater in diameter. When not otherwise called for by plans or specifications, rivets shall have standard button or cone heads of uniform size for the same size rivet. The heads shall be concentric with the holes. Countersunk rivets shall be flush with the surface and fill the countersink.

40. **Fit of Fillers, Braces and Reinforcing Bars.** Fillers, except as otherwise called for or permitted by plans and specifications, shall fit closely into the fishing space of the rail and into the fillets of the web for not less than ½ in. below the head and above the base flange. When the raised brand of the rail interferes with fit of filler the brand shall be removed. Fillers shall be grooved or cut to clear rivet heads and bolt heads. Switch braces shall fit the fishing space of the rail when the brace is tight against the shoulder of the switch plate. Reinforcing bars shall fill the height of the fishing space of the rail.

41. **Plates and Bars.** All plates must be flat and true to surface. Bars must be straight and of the full size called for.

42. **Painting.** No paint, tar or other covering shall be used unless specified, and, in any case, shall not be applied before final inspection.

43. **Welding.** No welding shall be permitted on rails or on surfaces of other parts exposed to wheel wear. Welding in other portions may be permitted if in the judgment of the inspector the strength of the piece is not impaired.

44. **Marking.** The finished articles shall be plainly stamped with ¾-in. figures and letters for identification. The manufacturer's name or initials, section and weight of rail and month and year of manufacture must be stamped on a rail portion of the structure not exposed to wheel wear and where marking can be plainly seen, or may be stamped on a separate rust-proof plate, riveted to the web of the rail, in which case smaller letters may be used. Frogs must be marked with the frog number. All loose parts or fixtures shall be similarly stamped with suitable size letters and figures, the stamping also to show the numbers of the parts appearing on the plan and detail number, where established. On cast parts all or part of the lettering may be cast on the piece. All heat-treated bolts shall be marked on the head with letter or symbol indicating the manufacturer.

IV. Inspection

45. Material and workmanship shall be at all times subject to inspection by a duly authorized representative of the purchaser. The inspector shall have all reasonable facilities afforded to him by the manufacturer to examine the work during its progress, as well as the finished product, to satisfy himself that the work is manufactured and finished in accordance with these specifications.

46. All inspection shall be made at the place of manufacture. Tests of material may be made at the expense of the manufacturer if the amount of any particular kind of material is 50 tons or more. If less than 50 tons, the manufacturer shall certify that it is furnished in accordance with this specification; however, if the purchaser desires that a test be made he shall bear the expense of same, unless the material fails to met the specifications, in which case the manufacturer shall stand the expense of such test. For the rails used in the work the manufacturer, when requested, shall supply the purchaser with a certificate of inspection from the rail manufacturer.

47. The acceptance of any material by an inspector shall not prevent subsequent rejection if found defective after delivery, and such defective material shall be replaced by the manufacture at his own expense.

Requisites for Switch Stands, Including Connecting Rods

The committee recommended that article "Requisites for Switch Stands" on page 168 be withdrawn, and the following substituted:

1. Provision shall be made for spiking or bolting switch stands to two head blocks.

2. Classification of switch stands according to heights. (Height of switch stands is measured from top of tie to bottom of taper of lamp tip):

A. High Switch Stands: Height greater than 14 ft.; standard height, 18 ft.

B. Intermediate Switch Stands: Height greater than 2 ft.; to and including 14 ft.. Standard heights: (a) First intermediate, 7 ft. 9 in.; (b) second intermediate, 6 ft.; (c) third intermediate, 4 ft.

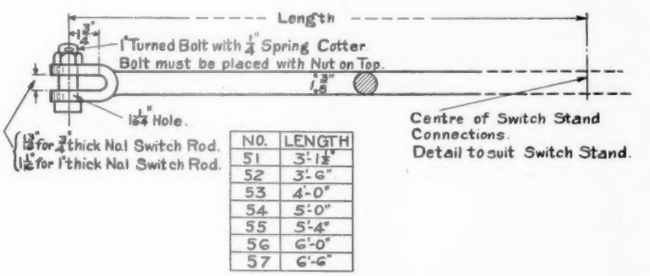
C. Low Switch Stands: Height greater than 1 ft.; to and including, 2 ft.

D. Extra Low Switch Stands: Height, 1 ft. or less.

3. The operating lever of extra low and low switch stands shall work parallel with the track.

4. The switch stand shall be so arranged that it can easily be inspected.

5. There shall be no lost motion in the bearings. The connections between the various points of the switch stand


Length
1" Turned Bolt with ¼" Spring Cotter
Bolt must be placed with Nut on Top.
1¼" Hole.
Centre of Switch Stand Connections.
Detail to suit Switch Stand.
½" for ¾" thick Nal Switch Rod.
½" for 1" thick Nal Switch Rod.

NO.	LENGTH
51	3'-1½"
52	3'-6"
53	4'-0"
54	5'-0"
55	5'-4"
56	6'-0"
57	6'-6"

Switch Stand Connecting Rods

shall be such as to insure against movement of switch points without corresponding movement of the operating lever.

6. The connection between the connecting rod and the switch stand shall be by a turned bearing of not less than 1⅛ in. diameter, and shall be so arranged that the separation cannot occur under operating conditions.

7. Provision shall be made for adjusting the throw of either or both switch points without moving the switch stand.

8. The throwing apparatus shall be so arranged that it will lock or latch in either extreme position without the use of the switch lock.

9. Lengths and details of connecting rods shall conform to plan No. 251, dated November 17th, 1920.

10. The target and lamp tip when used on a switch stand shall revolve through 90 deg. with the movement of the switch points, and indicate their position.

11. Shapes and sizes of targets shall conform to plan.....

12. Lamp tips shall conform to plan.....

On account of the variety in the detail of switch stands now on the market and the fact that many of the features are patented the committee recommended that it would

not be desirable to prepare plans nor complete specifications for switch stands, and in lieu thereof recommended the above. The requisites of switch stands have been drawn sufficiently broad to include the more efficient and complete switch stands now commercially available.

Appendix B—Typical Plans of Turnouts, Crossovers, Slip Switches, Double Crossovers and Railroad Crossings

The committee recommended the following plans for adoption:

Plan 901—Layout No. 6 Turnout and Crossover.
Plan 902—Layout No. 7 Turnout and Crossover.
Plan 903—Layout No. 8 Turnout and Crossover with Rigid Frogs.
Plan 904—Layout No. 8 Turnout and Crossover with Spring Frogs.
Plan 905—Layout No. 10 Turnout and Crossover.
Plan 906—Layout No. 11 Turnout and Crossover.
Plan 907—Layout No. 16 Turnout and Crossover.
Plan 908—Layout No. 20 Turnout and Crossover.
Plan 190—Diagram Preferred Names for Split Switches with Uniform Risers.
Plan 191—Diagram Preferred Names for Split Switches with Graduated Risers.
Plan 390—Diagram Preferred Names for Bolted Rigid Frogs.
Plan 490—Diagram Preferred Names for Spring Rail Frogs.
Plan 590—Diagram Preferred Names for Guard Rails.
Plan 690—Diagram Preferred Names for Rail Bound Manganese Steel Frogs.
Plan 691—Diagram Preferred Names for Solid Manganese Steel Frogs.

The plans of turnouts and crossovers, Nos. 901 to 908, inclusive, are the result of study of several railroads. Attention is called to using short ties in the crossovers to eliminate the heavy expense of longer ties, which are used as alternates. These plans were published as information in supplement to Bulletin 221, and in Vol. 21 of the Proceedings. As the changes from previous publication are of a minor nature only, principally in modifying some of the tie lengths, they were not reprinted.

The following changes were recommended on the plans adopted at the March convention, 1920:

Plan 501—Details of guard rails: Make the following changes in gage line diagram to show dimension line between gage line of frog point and guard line of guard rail, stating this distance must be maintained 4 ft. 6¾ in. instead of showing this distance as 4 ft. 5 in. between guard line of wing rail and guard line of guard rail.

Plan 502—Details of guard rail fixtures: Under notes, the second item, correct to read "For 16-ft. 6-in. guard rails and for congested traffic, with 11-ft. guard rails, use two clamps, applied in position C-2"; and note under alternate should be revised to read "For 16-ft. 6-in. guard rails and for congested traffic, with 11-ft. guard rails, use two adjustable guard rail braces applied in position B-2."

The committee also recommended that the following plans be accepted as information:

Plan 309—No. 4 and No. 5 Bolted Rigid Frogs.
Plan 608—No. 4 and No. 5 Rail Bound Manganese Steel Frogs.
Plan 656—No. 4 and No. 5 Solid Manganese Steel Frogs.

The following plans for railroad crossings, dated November, 1920, were submitted as information and for criticism:

Bolted Rail Crossings:
Plan 701—Angle 50 to 90 deg., Three Rail Crossings.
Plan 702—Angle 50 to 90 deg., Two Rail Crossings.
Plan 703—Angle 35 to 50 deg. minus, Three Rail Crossings.
Plan 704—Angle 35 to 50 deg. minus, Two Rail Crossings.
Plan 705—Angle 25 to 35 deg. minus, Two Rail Crossings with easers.
Plan 706—Angle 25 to 35 deg. minus, Two Rail Crossings without easers.
Manganese Steel Insert Crossings:
Plan 751—Designs and dimensions of manganese steel inserts for angles 45 deg. to 14 deg. 15 min., Details A.
Plan 752—Designs and dimensions of manganese steel inserts for angles 45 deg. to 14 deg. 15 min., Details B.
Plan 753—Designs and dimensions of manganese steel inserts for angles 14 deg. 15 min. to 8 deg. 10 min.
Plan 754—Typical crossings, angles 35 deg. to 45 deg., Details A, with continuous easers.

GAGES & FLANGEWAYS FOR CROSSINGS.
SPECIFICATION OF SOME OF THE RAILROADS AND PRACTICE OF SOME OF THE CROSSING MAKERS IN THE ABSENCE OF SUCH SPECIFICATION.

	NAME OF R.R. OR MANUFR.	TANG.	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	25°	MAX.
THESE RAIL MAY BE WIDENED ¼ AS MUCH AS THE GAGE IS WIDENED, AS ALSO DO WEIR FROG & SW. CO.	B&O R.R.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8¾"	4'-8¾"	4'-8¾"	4'-8¾"	4'-8¾"	4'-9"											
		1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	2"											
	ERIE R.R.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8¾"	4'-8¾"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9⅛"	4'-9¼"						4'-9¼"
		1¼"	1¼"	1¼"	1¼"	1¼"	1⅜"	1⅝"	1⅝"	1⅜"	1⅜"	2"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"						2⅛"
	GRAND TRUNK	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8¾"	4'-8¾"	4'-8⅞"	4'-8⅞"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9¼"	4'-9¼"			4'-9¼"
		1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅜"	1⅜"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"	2⅛"	2⅛"	2⅛"	2⅛"		2⅛"
	I.C.R.R. CENTRAL OF GA Y.&M.V.R.R.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8¾"	4'-8¾"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9¼"	4'-9¼"			
		1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1⅜"	1⅜"	1⅝"	1⅝"	1⅜"	1⅜"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"		
	DT&I.R.R.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8¾"	4'-8¾"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9⅛"	4'-9¼"						4'-9¼"
		1¼"	1¼"	1¼"	1¼"	1¼"	1⅜"	1⅝"	1⅝"	1⅜"	1⅜"	2"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"						2⅛"
	C.B.&Q.R.R.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8¾"	4'-8¾"	4'-8¾"	4'-8¾"	4'-8¾"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9¼"	4'-9¼"	4'-9¼"	4'-9¼"	4'-9¼"	4'-9½"			4'-9½"
		1¼"	1¼"	1¼"	1¼"	1¼"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	2"	2"	2"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"	2⅛"	2⅛"			2⅛"
	FRISCO ROCK ISLAND C.&E.I.R.R.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8¾"	4'-8¾"	4'-8⅝"	4'-8⅞"	4'-9"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9⅛"	4'-9¼"							4'-9¼"
		1¼"	1¼"	1¼"	1¼"	1¼"	1⅜"	1⅝"	1⅝"	1⅜"	1⅜"	2"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"							2⅛"
	MORDEN	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8¾"	4'-8¾"	4'-8¾"	4'-8⅞"	4'-8⅞"	4'-8⅞"	4'-9"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9⅛"	4'-9⅜"	4'-9⅜"			4'-9½"	4'-9½"
		1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1⅝"	1⅝"	1⅝"	2"	2"	2"	2"	2"	2"	2⅛"	2⅛"	2⅛"	2¼"	2¼"	2¼"	2½"	2½"
	ELLIOT	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8¾"	4'-8¾"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9¼"	4'-9¼"			4'-9¼"
		1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1⅜"	1⅜"	1⅝"	1⅝"	1⅜"	1⅜"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"		
	ST.LOUIS FROG & SW.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅞"	4'-9"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9⅛"	4'-9¼"							4'-9¼"
		1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"	2⅛"	2⅛"	2¼"							2¼"
THESE RAIL MAY BE WIDENED THE FLANGEWAY THE SAME AMOUNT THE GAGE IS WIDENED	BETHLEHEM	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9⅛"										
		1¼"	1¼"	1¼"	1¼"	1¼"	1⅝"	1⅝"	2"	2"	2⅛"	2⅛"	2¼"	2¼"	2⅛"										
	C.F.&C.CO.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9"	4'-9"			
		1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1⅝"	1⅝"	1⅝"	2"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"	2¼"	2¼"	2¼"	2¼"		
	PETTIBONE MULLIKEN	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9⅛"	4'-9¼"	4'-9¼"	4'-9¼"	4'-9¼"	4'-9¼"		4'-9¼"
		1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1⅝"	1⅝"	2"	2"	2⅛"	2⅛"	2¼"	2¼"	2⅛"	2⅛"	2⅛"	2¼"	2¼"	2¼"	2¼"		2¼"
	AJAX	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"		4'-9"	4'-9½"
		1¼"	1¼"	1¼"	1¼"	1⅜"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	1⅝"	2"	2"	2"	2"	2"	2"	2⅛"	2⅛"	2⅛"	2⅛"	2¼"	2¼"
	RAMAPO.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9¼"	4'-9¼"	4'-9¼"	4'-9¼"	4'-9¼"		
		1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	2"	2"	2"	2"	2¼"	2¼"	2¼"	2¼"	2½"	2½"	2½"	2½"	2½"		
	FROG, SW. & MFG. CO.	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9"	4'-9"			4'-9"
		1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1½"	1½"	1¾"	1¾"	2¼"	2¼"	2¼"	2¼"	2¼"	2¼"	2¼"	2¼"	2¼"	2¼"		2¼"
	A.R.E.A. P 117 1915 MANUAL	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8½"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-8⅝"	4'-9"	4'-9"	4'-9⅛"	4'-9⅛"	4'-9¼"	4'-9¼"		4'-9¼"
		NO FLANGEWAY WIDTHS GIVEN.																						

Plan 757—Typical crossings, angles 25 deg. to 35 deg., Details A, without easers.
Plan 762—Typical crossings, angles 35 deg. to 45 deg., Details B, with continuous easers.

Appendix C—Gages and Flangeways for Curved Crossings

The committee submitted a theoretical study of the subject as information, and for criticism and comparison with results obtained in practice. An analysis of the results lead to the following conclusions:

(1) Practically all locomotives will operate on curves of 6 deg. or less laid to standard gage of 4 ft. 8½ in. and standard width of flangeway of 1¾ in.

(2) Locomotives with not more than two pairs of flanged drivers will operate over all curves within the limits of the table on standard gage of 4 ft. 8½ in. and 1¾ in. flangeway.

(3) The operation of locomotives with trucks is limited by the swing or lateral motion of the trucks and such locomotives will not take a sharper curve than the maximum swing, provided for thereon, permits.

(4) For locomotives with three or more pairs of flanged drivers "Free Gage" should preferably be used and practical width of flangeway made equal to F.G.—4 ft. 6¾ in. Exact figures call for slightly wider flangeway in numerous cases, but the usual side play of the axles will compensate for the difference. Minimum gage would call for a distance of less than 4 ft. 6¾ in. between gage line and opposite guard line, and should not be used through curved crossings. A practical minimum gage may be made equal to F. G.—½ (FG—MG) and flangeways made this practical minimum gage G—4 ft. 6¾ in.

(5) Gage and flangeway thus determined for the locomotive giving the greatest values will satisfactorily admit the operation of locomotives and trucks calling for lesser values.

In specifications for locomotive the degree of the sharpest curve over which it is to operate is usually given and necessary provision is then made in side play, setting of wheels, lateral motion of trucks and sometimes special provision for floating axles are added if further required for the type under consideration.

Gages and flangeways for curved crossings should similarly be specified for the type of locomotive that is to be operated over the crossing and that requires the widest gage and flangeway, according to wheel base, number of flanged drivers and maximum degree of curve for which it is arranged. If such details are not available, but the types of locomotives operating over the crossing are known, the greatest value of gage and flangeway for such types and given curve may be used.

Where no definite information is available the rule for gage as per 1915 Manual with the flangeway made = G—4 ft. 6¾ in. will admit most of the general types of locomotives with less than 10 drivers up to a 20-deg. curve, except where swing of trucks is insufficient. In locations where the operation is restricted to certain types of locomotives, the rule may give a wider gage than would be necessary.

Discussion

W. P. Wiltsee (Chairman): Nine subjects were assigned to the track committee this year. They have reported on six subjects. The matter relating to the revision of the Manual is shown in Appendix A. *I move the adoption of this spike, both the* 5/8 *and the* 9/16 *spike, for printing in the Manual as recommended practice.*

A. W. Newton (C. B. & Q.): What has prompted such a change from the type that is used by all the railroads at this time, and being manufactured at all the mills? The explanation refers to the design of the head of the spike only, and I wondered why there was such a change in the general design, whether it was for economical distribution of metal or what.

Chairman Wiltsee: The proposed spike increases the metal in the neck of the spike more particularly than any other place. Otherwise it is practically the same as the spike adopted by the Association in 1918.

(*Mr. Wiltsee's motion was carried.*)

Chairman Wiltsee: The next item is specifications for switches, frogs, crossings and guard rails. *I move that these specifications be adopted as recommended practice and substituted for those now in the Manual.*

(*Motion carried.*)

Chairman Wiltsee: Considerable detail is given to show how the committee designed its frogs and switches. These take the place of the designs that are now in the Manual, and agree with the plans that we have already prepared. *I move their adoption as recommended practice and for printing in the Manual.*

(*Motion carried.*)

Chairman Wiltsee: The tables of turnout leads are simply a revision of those tables now in the Manual to agree with the different frog lengths that have been approved by the Association. *Therefore, I move their adoption.*

(*Motion carried.*)

(Typical plans of turn-outs, cross-overs and slip switches, and the plans showing diagrams of preferred names of parts were presented in turn for adoption and accepted.)

Chairman Wiltsee: In regard to Plan 501, as long as the standard frog has a flangeway of 1¾ in., this does not mean anything different, but provides in case of necessity for widening the flangeway, the committee thinks that the gage that should be maintained is from the back of the guard rail to the frog point.

(Mr. Wiltsee then read the matter relating to Plan 502.)

Chairman Wiltsee: These plans were not reprinted, as they were adopted last year, and the committee wish to make these two changes and *I therefore move their adoption.*

J. W. Ambrose (Tor. Term.): I will ask the committee how they arrive at the distance 4 ft. 6¾ in.; in other words, how do they justify the flangeway of 1¾ in.?

Chairman Wiltsee: The flangeway of 1¾ in. was adopted years ago as the flangeway required.

(*Motion carried.*)

C. W. F. Felt (A. T. & S. F.): I move that Plans 331 to 335 with the clamp frog be published in the Manual.

J. L. Campbell (E. P. & S. W.): I wish to compliment the committee on track on the very excellent designs of frogs which it has submitted from time to time to this Association and in which the design of the clamp frog is included. Speaking from an experience of 15 years with the clamp frog, I wish to say that I consider the design for the clamp frog submitted by this committee second to no design I have ever seen. I do not believe that it is the purpose of this Association to limit unnecessarily the recommended practice of the Association, and that if there is a choice between good articles, that the members of the Association ought to have the freedom of that choice. This committee is not recommending to the Association that you use this frog in preference to that frog, but rather that if you desire this type of frog it will be good practice for you to construct it according to this design.

(*Motion to adopt Plans 331 to 335 carried.*)

Chairman Wiltsee: The next matter is Gages and Flangeways for Curved Crossings, which will be presented by V. Angerer, chairman of the special committee.

V. Angerer: During the preparation of the plans for crossings, the question arose as to the proper gage and width of flangeways in curved crossings. Some roads have made investigations of their own on this subject. and the committee gathered information as to the number. The tabulation thereof was sufficient to show the great diversity in practice in the width of gages and flanges on curved crossings. The committee then decided to make a study as to how the different factors which affect the gage and width of flanges would work out theoretically. The factors, which are the determining points, are the wheel base, the number of flanged wheels, semi-rigid connection and diameter of the wheels. From these the committee has worked out some formulas and tables.

The swing given in these tabulations is the swing that would be necessary to allow the locomotive to take the

curve with the driver arrangement which it has, but is really in itself excessive in some cases. It is not practicable to give that much swing on the locomotive.

There are some factors which cannot be determined theoretically. One is the flexibility in the tender of the locomotive and its parts and also with regard to the flexibility of the tracks or the crossings, which, as we build them now, are not very flexible.

T. E. Rust (W. C. F. & N.): If I am not very much mistaken this Association adopted standard flangeways for both straight and curved track in 1917.

Chairman Wiltsee: I would like to know if this question is ever taken into consideration. Apparently it has been some years preceding. The question of curved crossings is certainly bad practice. Who would put in a curved crossing that could possibly be avoided? I have recommended to my Board a great many crossings of railroads, but I do not think I have ever passed one crossing on a curve. I do not think it is good practice.

W. M. Camp (Railway Review): Mr. Chairman, it is true that no one puts in curved crossings, but there are other arrangements that introduce similar conditions, for instance, a frog on a curve, a frog on the outside of a curve or on the inside of a curve introduces conditions which are essentially similar that you would have in a flangeway on a curved crossing.

C. J. Coon (N. Y. C.): In the Grand Central terminal we use a 4-ft. 9-in. gage. We have turnouts as high as 18 deg. constantly under regular traffic. The flangeway of the frogs is 1⅞ in. The distance the guard rail is set from the wing rail of the frog is 4 ft. 4⅞ in., and we have never had any derailment which was attributed to this gage or to the setting of these guard rails at these distances.

We operate multiple-unit electric equipment over 42-deg. 40-min. curves, with a 4-ft. 9-in. gage, and a flangeway in the frog of 2 in., without derailment.

The Chairman: The supplement to the Manual in 1918 provides for a flange 1¾ in. wide, or with provision for an increase of 1/16 of an inch for every 2 deg. of curvature, and on that recommendation that is the practice now, reflected by the Manual.

Is there any further discussion of this, which, as I stated before, is merely received for information this year. If not, we will pass to the next subject.

Chairman Wiltsee: The next portion of the report is Appendix D. Mr. Macomb will present the report.

(J. de N. Macomb (A. T. & S. F.) read Appendix D, and also abstracted portion of Appendix D relating to switch stands.)

Chairman Wiltsee: *It is the recommendation of the Committee that this matter be adopted as recommended practice, and printed in the report. I therefore so move you.*

(*Motion carried.*)

Chairman Wiltsee: Plans and specifications for tie plates, derailers and anti-creepers in Appendix E is simply a progress report, and no conclusions have been reached. H. T. Porter, chairman of the sub-committee, will present the report.

(H. T. Porter (B. & L. E.) presented the report.)

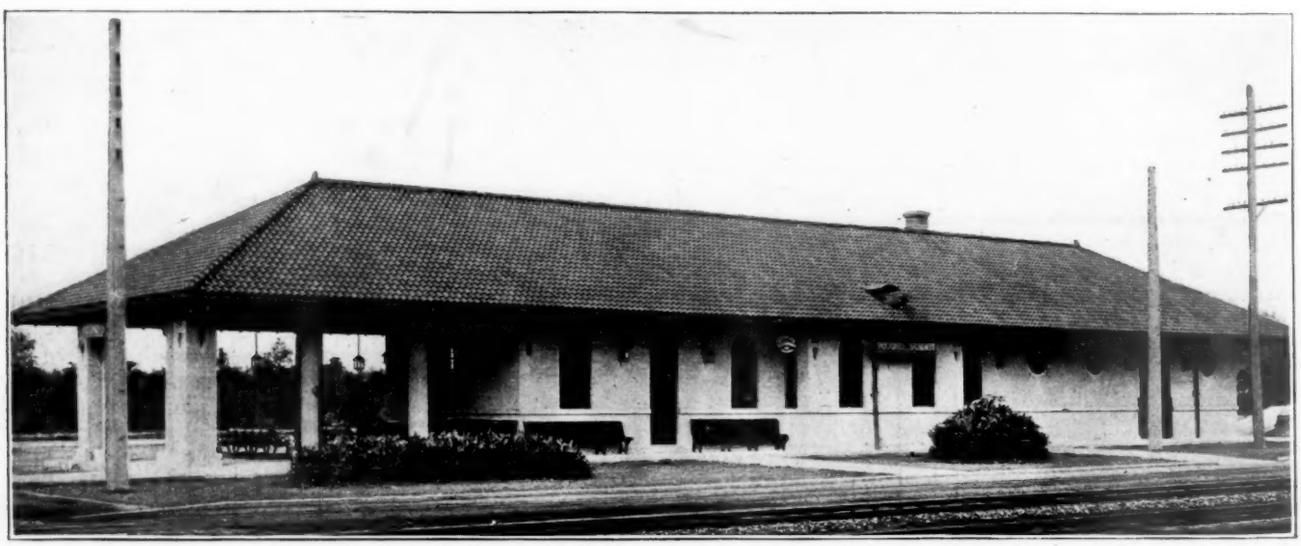
The Chairman: This report, gentlemen, is offered as information, with the request for constructive criticism during the coming year.

Chairman Wiltsee: The next sub-division is Study and Report on Specifications and Piece Work Schedules for Contracting Track Maintenance Work. This part of the report will be presented by E. T. Howson.

E. T. Howson (*Railway Age*): Owing to the abnormal conditions with which we are all familiar which have prevailed during the past year in getting work done by contract or by any other means, it was very difficult for your committee to find any clean-cut examples of contract work. The standard track work system which had been in effect for several years on the B. & O. and for a shorter time on the Pennsylvania, prior to federal control, and which were abandoned during that control, have not yet been re-established. Therefore, the committee was unable to get any up-to-date information on which to base any report.

While a good many roads resorted to the cost-plus form of contract in one form or another last year, the committee did not consider that was the kind of contract the Board of Direction had in mind in assigning this subject, in most cases the cost-plus form of contract being little more than paying the contractor a percentage on the cost of his work for recruiting the force. Therefore the committee can only report progress.

(The committee was excused with the thanks of the Association.)



Simplicity Is the Keynote of the Lackawanna at Pocono Summit, Pa.

Report of Committee on Stresses in Track

The work of the committee has resulted in the collection of a large amount of data relative to the stresses developed in curved and tangent track which will require considerable time for analysis and presentation in a final report. In securing this data field tests were made by methods similar to those employed in the preparation of last year's report. Work of a preliminary nature was performed to find the effect of flat spots on wheels upon the stress in the rail. The principal purpose of this year's tests was to find the effect of curvature upon the stresses in the rail caused by different types of locomotives as compared with the stresses developed in straight track.

A. N. Talbot
Chairman

A. N. Talbot has been chairman of the committee since its creation seven years ago. He has also been active in other professional societies, having been president of the American Society of Civil Engineers in 1918. As professor of civil engineering at the University of Illinois he is brought into intimate daily contact with intricate problems of engineering research. His long experience in directing field investigations in the laboratory and field eminently fits him to guide the extensive and complicated investigations which constitute the basis for the work of the committee, while his connection with the university forms a valuable alliance for the committee.

IN CONTINUATION OF THE PROGRAM of the committee, field tests on railroad track were carried on during the summer season. The tests were conducted on the tracks of the Illinois Central in Illinois, the Delaware, Lackawanna & Western in New Jersey, and the Atchison, Topeka & Santa Fe in New Mexico and Iowa. The tests were made on tangent track and on curved track, several different curvatures being used. A principal purpose of the tests was to find the effect of curvature of track upon the stresses in the rail (including lateral bending stresses) caused by locomotives of different type run at different speeds, as compared with the stresses developed in straight track. Several types of locomotives were used—Pacific, Mountain, Santa Fe, Mikado, Ten-Wheeler, etc. Work of a preliminary nature was also done to find the effect of the flat spots of wheels upon the stress in the rail. All the tests were carried on in much the same way as were the tests described in the reports of the committee already presented to the Association. A large amount of data has been accumulated, and it will require several months to reduce these data and a further time to study the results. Preliminary work on the data indicates that the tests will give important information on stresses developed in curved track. The committee is also continuing work on other phases of the subject assigned to it.

Committee: A. N. Talbot (U. of Ill.), chairman; W. M. Dawley (Erie), vice-chairman; A. S. Baldwin (I. C.), G. H. Bremner (I. C. C.), John Brunner (Ill. Steel Co.), W. J. Burton (M. P.), Chas. S. Churchill (N. & W.), W. C. Cushing (Penna.), Dr. P. H. Dudley (N. Y. C.), H. E. Hale, Robt. W. Hunt, J. B. Jenkins (B. & O.), Geo. W. Kittredge (N. Y. C.), Paul M. LaBach (C. R. I. & P.), C. G. E. Larsson (Am. Br. Co.), G. J. Ray (D. L. & W.), Albert Reichmann (Am. Br. Co.), H. R. Safford (C. B. & Q.), Earl Stimson (B. & O.), F. E. Turneaure (Univ. of Wis.), J. E. Willoughby (A. C. L.).

Discussion

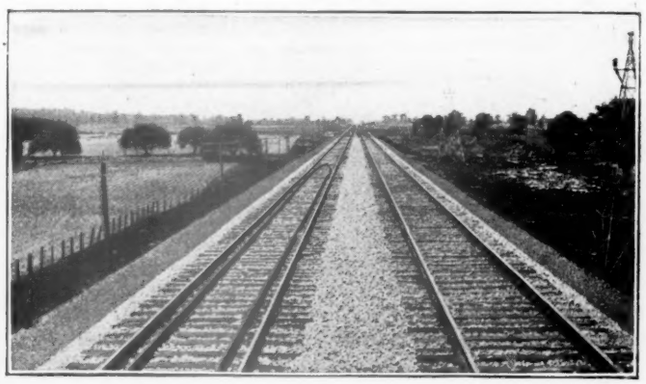
Prof. A. N. Talbot (Chairman): Since the report was written considerable progress has been made in reducing the data on curves. Attention may be called to the large bending stress in the inner rail over the third or fourth driver, according to the type of locomotive. The bending stress decreases in this inner rail with an increase of speed. For the outer rail there is considerable lateral bending over the front truck and first driver, and over the last driver and trailer, and this bending increases with increase of speed.

Measurements were made of the lateral bending of the rail section on itself (tilting) and also of the bending developed in the rail in a 6-ft. length, as would be produced as the engine passed at low speed. High stresses were found in the rail under wheels having flat spots. Tests in the laboratory are being carried on to learn how the splice bar and rails act at a joint and how the stresses are transmitted from rail to bar, as well as the amount of stress developed. It may be said that we have still a large amount of work to do before the results of data already secured will be ready for presentation, or even for discussion.

(The committee was dismissed with the thanks of the Association.)

(Adjourned.)

Crooked River Arch on the Oregon Trunk Line



A Typical Section of Track as Found on the Lehigh Valley

National Railway Appliances Association Meeting

G. C. Isbester Elected President; Members Well Satisfied With This Year's Exhibit

THE NATIONAL RAILWAY APPLIANCES ASSOCIATION held its annual meeting in the restaurant of the Coliseum at 11 o'clock yesterday morning.

In reviewing the work of the year President J. B. Strong stated that "last year the space applications from old exhibitors exceeded that available by 20 per cent. This year, in adding the ballroom, we had 5,500 sq. ft., or about 17 per cent additional space to offer and were therefore able to take better care of our space applications though we still have applications for more space than available. At our last annual meeting the directors were asked to consider having a ladies' rest room for the next exhibit, and I am pleased to state we have now provided it in the southeast corner of the ballroom. We have also provided a lounging space and music in the gallery adjacent to the ballroom at the south end of the main building, which we trust is being found of convenience and interest to our visitors.

"The oak and wicker furniture provided this year is comfortable and of a unique design and a great improvement over that heretofore offered. It is all new, made especially for this exhibit at a considerable outlay in investment by the contractor, and has been furnished to our exhibitors at a reasonable rental.

"The added facilities and equipment have been provided without increasing our membership dues and with but a small increase in our space rental rates. It is too early to state just how our income and expenses will balance, but present estimates indicate a close balance with only a small deficit.

"I wish to take this opportunity of thanking the members of the board of directors, and especially our secretary-treasurer, Mr. Kelly, for their hearty co-operation throughout the past year by their attendance and interest in all meetings called, which has enabled this exhibit to be so successfully opened to railroad men."

REPORT OF SECRETARY-TREASURER

Secretary-Treasurer C. W. Kelly reported that the exhibit will probably create a deficit of between $1,800 and $2,000. Last year our attendance on Monday was 2,084; this year at the same hour it was 3,566.

OTHER BUSINESS

By a unanimous vote the transactions of the Board of Directors for the past year were approved.

A vote of thanks was extended to the retiring officers for the completeness of the furniture equipment of the booths. There was a general expression of satisfaction with the exhibit.

ELECTION OF OFFICERS

The Nominating Committee, composed of P. C. Jacobs, Johns-Manville, Inc., chairman; L. B. Sherman, *Railway Age;* A. Anderson, Adams & Westlake Co.; E. E. Hudson, Waterbury Battery Co., and G. R. Lyman, William Wharton, Jr., Company, recommended the following officers for the coming year, and two directors to serve for three years, which recommendations were adopted:

President—George C. Isbester, American Chain Company, Chicago.

Vice-President—Thomas W. Aishton, National Malleable Castings Company, Chicago.

Directors for a three-year term—A. A. Taylor, Fairbanks, Morse & Co., Chicago, and G. E. Geer, western manager, Wyoming Shovel Company, Chicago.

G. C. Isbester, who was elected president, is the district sales manager of the American Chain Company, Chicago. Mr. Isbester was connected with the mechanical department of the Great Northern at St. Paul, Minn., from 1897 to 1899, leaving the Great Northern at this time to go with the Sargent Steel Company, with headquarters at Chicago. He remained with this company until about 1902, when he went with the Q & C Company, with headquarters at Chicago, afterwards becoming vice-president of that company. In 1912 he went with the Rail Joint Company as district sales manager. During the war Mr. Isbester served in the United States Naval Reserve Forces as lieutenant commander, having been on active duty from April, 1917, until he was placed on the inactive list in May, 1919. He was recalled to active duty on July 28, 1919, to be sworn in as commander in the supply corps. He was selected for promotion from lieutenant commander to commander by the Board of Selection, and after receiving his promotion he was again detached from active duty. Commander Isbester also served with the Illinois Naval Militia for ten years. On his return from the navy Mr. Isbester again resumed his duties with the Rail Joint Company as district sales manager, which position he resigned on August 1, 1919, to enter the service of the American Chain Company, Inc., with headquarters at Chicago.

American Railway Engineering Association Registration

THE REGISTRATION of members and guests of the American Railway Engineering Association yesterday totalled 593, as compared with a similar registration for the first day a year ago of 534. The crowded condition of the convention room yesterday reflected this large attendance.

Abbott, F. E., Insp. Engr., Lackawanna Steel Co., Buffalo, N. Y.
Adams. L. L., Roadmaster, L. & N., Etowah, Tenn.
Adamson, J. H., Asst. Engr., B. & O., Meyersdale Pa.
Albaugh, R. B., Div. Engr., St. L. S. W., Tyler, Texas.
Allan A. G. Asst. Engr. Mo. Pac., St. Louis, Mo.
Allen, L. B., Supt. M. W., C. & O., Huntington, W. Va.
Ambrose, J. R. W., Chief Engr., Toronto Term., Toronto, Ont., Canada.
Amory G. F., Asst. Engr., C. T. H. & S. E., Chicago.
Amoss, F. X., Can. Gov. Rys., Corinth, Ont., Can.
Anderson, Arthur, Instrumentman, N. Y. C., Chicago.
Anderson, Irving, Div. Engr., A. T. & S. F., Marceline, Mo.
Andrews, Lamont, Ch. Engr., S. A. & A. P., San Antonio, Tex.
Angerer, Victor, Vice-Pres., Wm. Wharton, Jr., & Co., Easton, Pa.
Angier, F. J., Supt. Tim. Pres., B. & O., Baltimore.
Armour, Robert, Masonry Engr., Grand Trunk, Montreal, Can.
Armstrong H. J. Asso. Prof. C. E., Armour Inst., Chicago.
Armstrong, J. E., Asst. Engr., Canadian Pac., Montreal, Que.
Arn, W. G., Asst. Engr. M. W. I. C., Chicago.
Atwill, A. Lee, Asst. Engr., Chicago & Western Indiana, Chicago.
Atwood, Col. Wm. G., Woods Bros. Const. Co., St. Louis, Mo.
Auryansen, F., Bridge Eng., Long Island, Jamiaca, N. Y.
Austill, H., Bridge Engineer, M. & O., St. Louis, Mo.
Aylsworth, R. G., Asst. Engr., C. B. & Q., Denver, Colo.
Babcock, J. B. (III), Asst. Prof. Ry. Eng., M. I. T., Cambridge, Mass.

Backes, W. J., Engr., N. Y. N. H. & H., New Haven, Conn.
Badger, O. C., Asst. Eng., A. T. & S. F., Chicago.
Baker, W. E., Asst. Engr., L. & N., Ravenna, Ky.
Baldridge, C. W., Asst. Engr., A. T. & S. F., Chicago.
Baldwin, A. S. (Past-President), Vice-President, I. C., Chicago.
Baldwin, Hadley (Director), Asst. Ch. Engr., C. C. C. & St. L., Cincinnati, Ohio.
Baldwin, L. W., Vice-President, I. C., Chicago.
Baldwin, R. A., Dist. Engr., C. N. R., Toronto, Can.
Ballard, E. E., Office Engr., M. K. & T., St. Louis, Mo.
Baluss, F. C., Engr. B. and B., D. M. & N., Duluth Minn.
Bardwell, R. C., Engr. Water Service, M. P., St. Louis, Mo.
Barrett, W. C., Trainmaster, Lehigh Valley Sayre, Pa.
Barry, H. B., Prin. Asst. Eng., St. L.-S. F., St. Louis, Mo.
Batchellor, F. D., Div. Engr. B. & O., Garrett, Ind.
Bates, Onward, Con. Engr., Chicago.
Beach, D. P., Div. Eng., Penn. System, Indianapolis, Ind.
Beach, Dr. S. C., Health Officer, I. C., Chicago.
Beahan, Willard, First Asst. Engr., N. Y. C., Cleveland, O.
Bell, Gilbert J., Engr. West. Dist., A. T. & S. F., Topeka, Kan.
Bertram, H. A., Div. Eng., C. & O., Peru, Ind.
Betts, E., Asst. Cons. Engr., Sou. Pac., New York City.
Beugler, Edwin J., Vice-Pres., Foundation Co., New York City.
Beye, John C., Oak Park, Ill.
Bissell, F. E., 729 Garfield Bldg., Cleveland, Ohio.
Black, G. F., Eng. M. of Way, Maine Cen., Portland, Me.
Blackie, G. F., Asst. Ch. Engr., N. C. & St. L., Nashville. Tenn.
Blackman Chas. H., Prin. Assist. Engr., L. & N., Louisville, Ky.
Blaiklock, M. S., Engr. M. of W., Grand Trunk, Montreal, Can.
Blake, H. S., Asst. Engr., Norfolk Southern, Norfolk, Va.
Blum, Bernard, Engr. M. W., N. P., St. Paul, Minn.
Boardman, H. E., Engr. Asst. to Gen. Val. Coun., N. Y. C., New York City.
Bohnstengel, W., Asst. Engr. Tests, A. T. & S. F., Topeka, Kan.
Bond, F. L. C., Chief Engineer, G. T., Montreal, Can.
Bond, T. S., Asst. Engr., I. & G. N., Palestine, Texas.
Borchert, W. C., Dist. Engr., M. K. & T., Smithville, Tex.
Bowser, E. H., Supt., Timber Dept., I. C., Memphis, Tenn.
Boyd, G. E., Div. Engr., D. L. & W., Buffalo, N. Y.
Brameld, W. H., Engr. Asst. to Gen. Mgr., Erie, New York. City.
Breckinridge, W. L., Asst. Chief Engr., C. B. & Q., Chicago.
Bremner, Geo. H. (Treasurer), Dist. Engr., Bureau of Valuation, Interstate Commerce Commission, Chicago.
Brewer, W. A., Asst. Engr., C. & N. W., Chicago.
Brown, A. V., Engr. M. W., Lake Shore Electric, Sandusky, Ohio.
Brown, H. C., Jr., Chicago.
Brown, J. M., Corp. Engr., Maint. and Const., C. R. I. & P., Chicago.
Brumley, D. J., Chief Engr., Chicago Ter. Imp., I. C., Chicago.
Brunner, John, Asst. Insp. Engr., Ill. Steel Co., Chicago.
Buck, C. M., Div. Engr., A. T. & S. F. Topeka, Kans.
Buehler, Walter, Cons. Engr., The Barrett Company, New York City.
Burns, J. F., Asst Engr., M. W., L. & N., Louisville, Ky.
Burpee, G. W., Man. Engr., Westinghouse, Church, Kerr Co., New York City.
Burpee, Moses, Ch. Eng., B. & A., Houlton, Me.
Burrell, Chas. F., Eng. M. of Way, K. & I. T., Louisville, Ky.
Burt, A. M., Asst. to Vice-Pres., N. P., St. Paul, Minn.
Burt, J. W., Div. Engr., C. C. C. & St. L., Indianapolis, Ind.
Camp, W. M., Editor, Railway Review, Chicago.
Campbell, J. L. (Second Vice-President), Ch. Engr., E. P. & S. W., El Paso, Texas.
Carothers, J. B., Asst. to G. M., B. & O., Lines West, Cincinnati, Ohio.
Carpenter, H. R., Asst. Ch. Engr. Con., M. P., St. Louis, Mo.
Cassil, H. A., Eng. M. of Way, P. M., Detroit, Mich.
Chamberlain, O. P., President, C. & I. W., Chicago.
Chevalier, C. R., Roadmaster, Portland Term., Portland, Me.
Chinn, Armstrong, Instrumentman, Engr. Dept., C. B. & Q., Chicago.
Christian, W. A., Sp. Engr., M. & St. L., Chicago.
Christiansen, Eli, Asst. Engr. of Bldgs., C. R. I. & P., Chicago.
Church, S. R., Man. Tar and Oil Div., The Barrett Co., New York City.
Churchill, Chas. S. (Past-President), Vice-President, Norfolk & Western, Roanoke, Va.
Clapper, Leland, Engr. B. & B., D. & I. R., Two Harbors, Minn.
Clark, W. A., Chief Engr., D. & I. R., Duluth, Minn.
Clarke, A. C., Dist. Engr., B. & O., Pittsburgh, Pa.
Clarke, R. N., Asst. Engr., Mo. Pac., Kansas City, Mo.
Clements, M. F., Bridge Engr., Nor. Pac., St. Paul, Minn.
Coburn, Maurice, Engr. M. W., Pennsylvania System, Indianapolis, Ind.
Cochran, Charles W., Major, U. S. A., Mil. Dept., U. of Ala., University, Ala.
Condron, T. L., Con. Engr., Chicago.
Conner, J. K., Chief Engr., L. E. & W., Indianapolis, Ind.
Conner, E. H., C. E., Mo. V. Br. & I., Leavenworth, Kan.
Cook, R. A., Val. Engr., C. & A., Chicago.
Cook, R. L., Office Engr., Central of Georgia, Savannah, Ga.
Coon, C. J., Engr. Gr. Cen. Terminal, N. Y. C., New York.
Cox, J. B., Con. Engr., Chicago.
Craine, Arthur, Div. Engr., C. B. & Q., St. Joseph, Mo.
Craine, Lawrence, Asst. Engr., Val., M. P., St. Louis, Mo.
Cramer, F. H., Asst. Br. Engr., C. B. & Q., Chicago.
Crane, E. B., Chicago.
Cummins, R. R., Roadmaster, Cen. of Ga., Macon, Ga.
Cunningham, A. O., Chief Engr., Wabash, St. Louis, Mo.
Cunningham, C. C., Div. Engr., C. R. I. & P., Herington Kan.
Curd, W. C., Con. Engr., Chicago.
Cushing, W. C. (Past-President), Engr. of Standards, Pennsylvania System, Philadelphia, Pa.
Cutler, A. S., Asst. Prof. Ry. Engr., Univ. of Minn., Minneapolis.
Dakin, A. H., Jr., Asst. Engr., C. of N. J., New York City.
Dale, L. E., Supv. Penna. Sys., Philadelphia, Pa.
Daley, C. A., Div. Engr., Erie, Salamanca, N. Y.
Dalstrom, O. F., Engr. of Bridges, C. & N. W., Chicago.
Dare, C. E., Res. Engr., R. F. & P., Alexandria, Va.
Darrow, F. T., Asst. Ch. Engr., C. B. & Q. Lincoln, Neb.
Davidson, Geo. M., Chemist & Engr. Tests, C. & N. W.,
Davis, A. L., Prin, Asst. Engr., I. C., Chicago.
Davis, Garrett, Asst. Engr., C. R. I. & P., Chicago.
Davidson, J. C., Engr. Elec. Tr., N. & W., Bluefield, W. Va.
Davidson, J. H., Water Engr., M. K. & T., Dallas, Tex.
Deckert, J. E., Ch. Draftsman, Val. Dept., C. B. & Q., Chicago.
DeGeer, B. W., Engr. W. S., Gt. Nor., St. Paul, Minn.
Delamere, C. T., Engr. Const., C. P., Montreal, Canada.
Dennis, Walt, Div. Engr., Wabash, Moberly, Mo.
Dodgson, F. L., Con. Engr., Gen. Ry. Sig. Co., Rochester, N. Y.
Donahey, J. A., Cleveland, Ohio.
Dorley, A. F., Dist. Engr. M. W., E. Lines, M. P., St. Louis, Mo.
Dorrance, W. T., Design. Engr., N. Y. N. H. & H., New Haven, Conn.
Douglas, H. T., Jr., Chief Engr., C. & A., Chicago.
Downs, J. L., Roadmaster, I. C., Champaign, Ill.
Downs, L. A. (First Vice-President), Vice-President and General Manager, Cen. of Ga., Savannah, Ga.
Duffy, C. M., Asst. Sig. Engr., C. R. I. & P., Des Moines, Iowa.
Dufour, F. O., Structural Engr., Stone & Webster Engr. Corp., Boston.
Durham, E. M., Jr., Mgr. Dept. & S., Div. of Liq. Claims, U. S. R. A., Washington, D. C.
Dyke, R. L., Div. Engr., Erie, Elmira, N. Y.
Earle, Thos., V. P., Bethlehem Steel Br. Corp., South Bethlehem, Pa.
Eck, W. J., Sig. and Elec. Supt. Sou, Washington, D. C.
Edgerton, H. H., Engr. of Surveys, C. G. W., Chicago.
Ellis, G. E. Secy., Auto. Train Control Com., Chicago.
Ellsworth, F. H., Div. Engr., N. Y., N. H. & H., New Haven, Conn.
Emmons, S. E., Asst. Engr., Ann Arbor, Owosso, Mich.
Entwisle, E. D., Ch. Eng., J. & S. C., Johnstown, Pa.
Ericson, E. G., Asst. to Chief Engr., Penna., Pittsburgh, Pa.
Evans, John, Div. Engr., M. C., Detroit, Mich.
Evans, W. T., Asst. Engr., C. & A., Chicago.
Fair, J. M., Asst. Supr., Penna, Philadelphia, Pa.
Fairbairn, J. M. R. (Director), Ch. Engr., Can. Pac., Montreal, Canada.
Farlow, G. B., M. of W., B. & O., Cincinnati, Ohio.
Farnsworth, M. H. Asst. Engr. Chicago Union Sta. Co., Chicago.
Farrin, J. A., Asst. Engr., I. C., Chicago.
Fechtig, F. H., Pur. Agt., A. C. L., Wilmington, N. C.
Felt, C. W. F., Ch. Engr., Santa Fe, Chicago.
Fenstermaker, D. C., Dist. Engr., C. M. & St. P., Chicago.
Fifield, H. F., Div. Engr., N. Y. N. H. & H., Taunton, Mass.
Fickes, C. R., Regional Engr., U. S. R. A., Chicago.
Filippi, Hugo, Asst. Engr., Chicago Term. Imp., I. C., Chicago.
Fisher, S. B., Engr. Dept., M. K. & T., Parsons, Kan.
Ford, C. F., Supr. of T. & T. Dept., C. R. I. & P., Chicago.
Fowler, W. E., Ch. Engr., Montour Railroad, Coraopolis, Pa.

Frink, E. A. (Director), Principal Asst. Engr., S. A. L., Norfolk, Va.
Fritch, E. H. (Secretary), Chicago.
Gagel, Edward, Ch. Engr., N. Y. N. H. & H., New Haven, Conn.
Galbreath, A. W., Val. Engr., M. K. & T., Parsons, Kan.
Gennet, C. W., Jr., Engr., R. W. Hunt & Co., Chicago.
Gersbach, Otto, Chief Engr., Ind. Harbor Belt, Gibson, Ind.
Gilcreast, F. W., Engr. Maint., L. & N. E., South Bethlehem, Pa.
Godlove, Geo. W., Jr., Office Engr., A. T. & S. F., Marceline, Mo.
Going, A. S., Engr. Const., Grand Trunk, Montreal, Can.
Goldstraw, Walter, Asst. Arch., Grand Trunk, Montreal Can.
Goodrich, C. M., Des. Eng., Canadian Br. Co., Walkerville, Ont.
Goos, J. H., Insp. Engr., G. N., St. Paul, Minn.
Grandy, A. L., Chief Engr., Pere Marquette, Detroit, Mich.
Grear, S. F., Ch. Draftsman, Br. Dept., I. C., Chicago.
Grime, E. M., Supv. B. & B., Nor. Pac., Fargo, N. D.
Haas, E. M., Mgr. R. R. Dept., The H. K. Ferguson Co., Cleveland, Ohio.
Hadwen, T. L. D., Engr. of Masonry Const., C. M. & St. P., Chicago.
Haislip, L. E., Div. Engr., Baltimore & Ohio, Parkersburg, W.Va.
Hale, H. E., Group Engr., Pres. Conference Com., New York City.
Hall, F. D., Elec. Engr., B. & M., Somerville, Mass.
Halpin, V. C., Asst. Engr., Mo. Pac., Little Rock, Ark.
Hamilton, G. F., Dist Engr., C. B. & Q., Alliance, Nebr.
Hamilton, Paul, Engr. Tr. & Roadway, Big Four, Cincinnati, Ohio.
Hammond, R. J., Office Engr., B. & M., Boston, Mass.
Hand, G. F., Gen. Asst. Engr., N. Y. N. H. & H., New Haven, Conn.
Hanger, Kenneth, Div. Engr., M. K. & T., Parsons, Kan.
Hannaford, A. R., Asst. Engr., Grand Trunk, Hamilton, Ont., Can.
Hansen, Oscar, Asst. Engr. B. & B., Cen. of Georgia, Savannah, Ga.
Harrington, C. J., Roadmaster, I. C., Memphis, Tenn.
Harris, G. H., Engr. M. Way, M. C., Detroit, Mich.
Harris, G. W., Asst. Ch. Engr., A. T. & S. F., Chicago.
Harris, P. H., Asst. Engr., T. & S. F., Port Arthur, Texas.
Harris, W. J., Div. Engr., C. B. & Q., LaCrosse, Wis.
Hartwig, C. E., Asst. Sig. Engr., C. R. I. & P., El Reno, Okla.
Harvey, W. C., Val. Engr., C. G. W., Chicago.
Hastings, E. M., Prin. Asst. Engr., R. F. & P., Richmond, Va.
Hatt, W. K., Prof. C. E., Purdue Univ., Lafayette, Ind.
Hawk, A. T., Engr. Bldgs., C. R. I. & P., Chicago.
Hawley, W. E., Asst. Engr., D. M. & N., Duluth, Minn.
Hayes, H. C., Asst. Engr., I. C., Champaign, Ill.
Heaman, J. A., Asst. Ch. Engr., G. T. P., Winnipeg, Canada.
Hegel, G. W., Chief Engr., Chicago Junction, Chicago.
Heimerdinger, W. E., Asst. Engr., C. R. I. & P., Des Moines, Iowa.
Hench, N. M., Engr. Tr. Appl., Carnegie St. Co., Pittsburgh, Pa.
Hendricks, V. K., Regional Engr., S. W. Region, U. S. R. A., St. Louis, Mo.
Henning, C. S., Const. Engr., E. P. & S. W. Sys., El Paso, Texas.
Hewes, C. A., Kansas City, Mo.
Hewson, E. G., Div. Engr., G. T., Toronto, Ont., Canada.
Hill, W. A., Special Engr., C. B. & Q., Chicago.
Hillegass, E. B., Engr. Roadway, A. C. L., Savannah, Ga.
Hinman, Dean, Asst. Engr., C. & G. W., Chicago.
Hoagland, J. R., Ch. Pilot Engr., C. & A., Chicago.
Hodgman, B. B., V. P. and Ch. Engr., Nat. Water Main Clg. Co., New York City.
Holmes, R. L., Engr. Water Service, T. & P., Dallas, Texas.
Holt, A. G., Asst. Ch. Engr., C. M. & St. P., Chicago.
Hotchkiss, L. J., Consulting Engineer, Chicago.
Howard, C. P., Senior Civil Engr., Bureau of Val., I. C. C., Chicago.
Howson, E. T., Western Editor, Railway Age, Chicago.
Hoyt, C. B., Supt. T. M. & C., N. Y. C. & St. L., Cleveland, Ohio.
Hoyt, W. H., Ch. Engr., D. M. & N., Duluth, Minn.
Hudson, H. W., Ch. Eng., Interstate, Norton, Va.
Hughes, L. J. F., Inspecting Engr., C. R. I. & P., Chicago.
Hunley, John B., Engr. Bridges and Str., Big Four, Cincinnati, Ohio.
Huntley, R. L., Chief Engr. (Asst. Gen. Mgr.), U. P., Omaha, Neb.
Huntsman, F. C., Asst. Engr., Wabash, Springfield, Ill.
Hurd, G. R., Supv. Fire Protection, I. C., Chicago.
Hynes, M. V., Gen. Supt., C. I. & W., Indianapolis, Ind.
Irving, T. T., Ch. Engr., Grand Trunk, Western Lines, Detroit, Mich.
Irwin, J. C., Val. Engr., B. & A., Boston, Mass.
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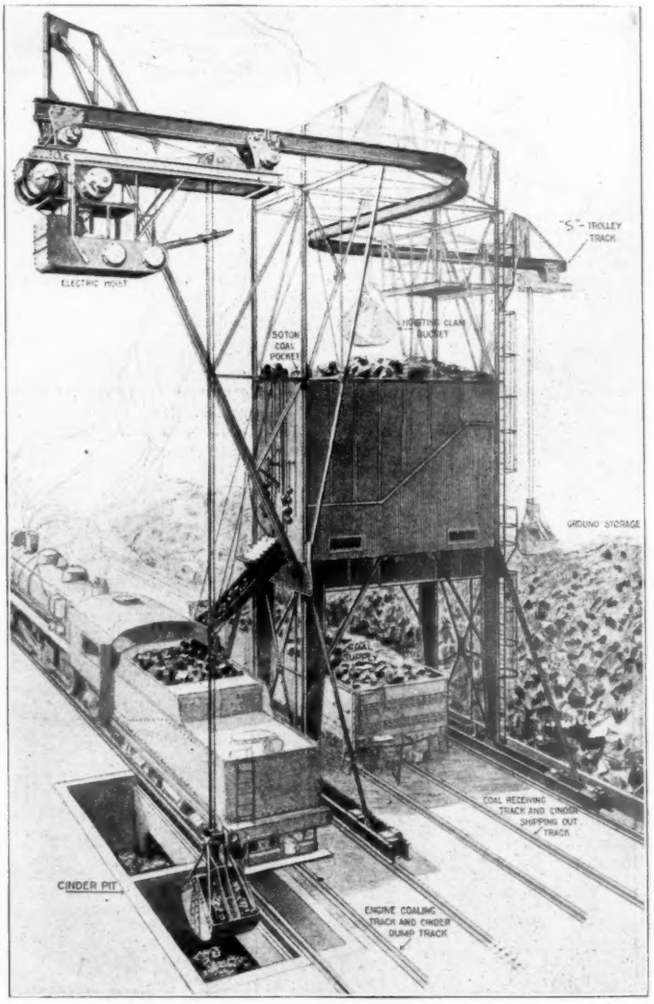
Weymouth, Harrison, Bethlehem Steel Co., Baltimore, Md.
Wharry, William, Gen. Roadmaster, G. T., St. Thomas, Ont.
Wilson, R. E., Assoc. Ry. Executives, Chicago.
Wilson, W. M., Assoc. Professor, University of Illinois, Urbana, Ill.
Wolverton, I. M., Pres., Mt. Vernon Bridge Co., Mt. Vernon, Ohio.
Woozley, D. E., Engr., M. W., U. R. R., East Pittsburgh, Pa.
Work, W., Resident Engr., G. T., Montreal, Que.

An Innovation in Coal Handling Equipment

On page 607 of yesterday's Daily there appeared an article describing a new type of mechanical coal and cinder handling plant developed by the Roberts & Schaefer Company, Chicago. In this plant the coal or



RandS Coaling Station and Cinder Plant

cinders are handled by a clam shell bucket operated from a trolley moving on a runway supported by a structural steel frame, the idea being to afford a wide range of use for the equipment, which may be applied equally well for coaling locomotives direct from cars, for storing coal or for reclaiming it or for handling cinders. Through an error the cut provided to illustrate this article was interchanged with another, so that the wrong cut was shown. For this reason we are here presenting the correct cut of the equipment.

A Correction

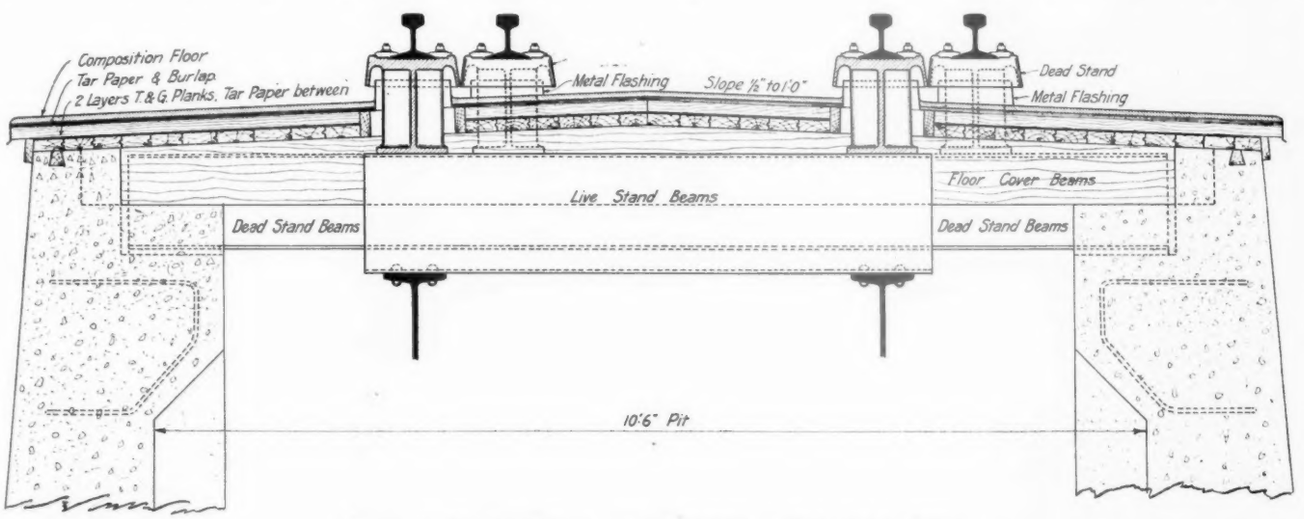
Owing to an error arising from the transposition of lines in the printshop the article describing the installatian of Fenestra window sash in a Pere Marquette round house at Plymouth, Mich., which appeared on page 603 of the *Daily Railway Age* of March 15, failed to credit this work to the Detroit Steel Products Company, Detroit, Mich., manufacturers of the sash. While it was evident to a reader that an error had been made, the correct name of the maker was not so evident.

Stresses in Track Meeting

There will be a meeting of the Committee on Stresses in Track in room 1102 in the Congress Hotel at 9 o'clock this morning.

A Weather Proof Track Scale Floor

FAIRBANKS, MORSE & Co., Chicago, has recently adopted a type of floor construction for its track scales which was developed by the Canadian Pacific recently. This design is a modified form of the earlier Fairbanks, Morse construction. It is of particular interest to railroads operating through regions similar to those of northern United States and of Canada, where the trouble resulting from the leakage of water into scale pits is not only one of corrosion but of interference with the free and accurate movement of the scale parts by ice formed when melted snow drips through the floor and strikes the cold scale iron.



Cross Sectional Plan of Weatherproof Track Scale Floor

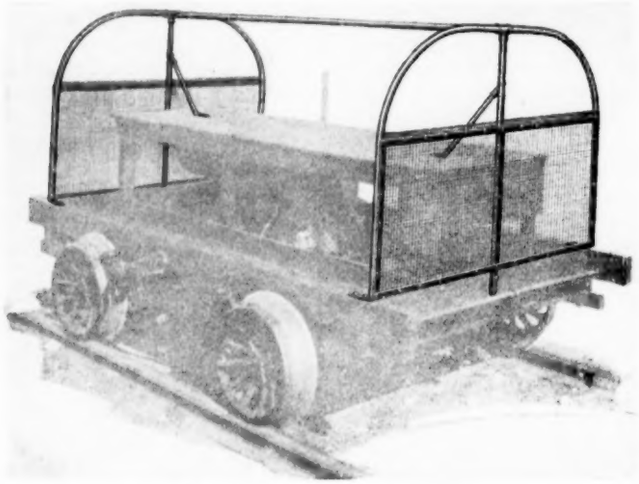
The floor as improved consists of a covering made up of two thickness of 1¼-in. tougue and groove planks extending crosswise to each other, separated by tar paper, and covered with three layers of tar paper and burlay painted with asphalt mastic. This floor slopes away from the center on a slope of ½ in. to 1 ft. and is carried on timber joists which span the pit. This independent condition of the floor joists is said to simplify the work of shaping the joists over the earlier method of carrying both the joists and the dead rail chairs on the same I beams. The live rail and dead rail chairs in this construction, instead of being different design, as in the earlier type of floor, are alike. Each rail chair extends 5 in. about the track floor and has an umbrella top of such a size as to project a sufficient distance out from and down over the galvanized flashing provided around the floor openings as to avoid contact and prevent the entrance of water into the pit at these points. It is evident that with this form of floor construction there is little opportunity for any water to pass through the deck and enter the scale pit from above.

Safety Railings for Motor Cars

AMONG THE DEVICES WHICH have recently been developed with special reference to the interest of safety, and whose range of application has been broadened, is a combined railing and end screen which Mudge & Co., Chicago, designed originally for use on motor cars of their construction, but which are now made to apply on any standard make of railroad section motor car or for push cars. In this construction two end frames supporting screens and connected at the top by a cross bar constitute the entire equipment, the frame work of which is made from heavy tubing bent to shape, connected by pipe fittings, and securely braced and bolted to the car body, while the screen is made of heavy woven wire held in place by iron strips bolted to the railings. The construction is substantial, adds but little weight to the car, and includes nothing capable of obstructing the free passage of the air, the screen purposely having a large mesh.

The screen prevents small tools from falling off the car and upon the track with resulting derailment, while it is also a guard against men being thrown off the cars or jumping off accidentally ahead of the car while in motion, and, in the case of push cars, of preventing passengers from riding with their feet suspended from the car. Aside from its function as a safety device it is said to be of value also in providing greater comfort for the men, in that men in a sitting posture can rest their backs against

the cross bar and that men, when standing (particularly the end men) are afforded a more substantial hold than that obtained by holding on each other or attempting to maintain a balance alone. Other points urged in favor of this device are that it affords an additional bracing to the car which tends to prolong its life; also that it makes for easier handling of the car by presenting a shoulder brace



Safety Railings on Motor Car

to the men lifting, that it makes the covering of the car with tarpaulin a more simple matter, and, finally, that it enables the men in starting the car to maintain practically an upright position while pushing.

An Improved Locomotive Type Crane

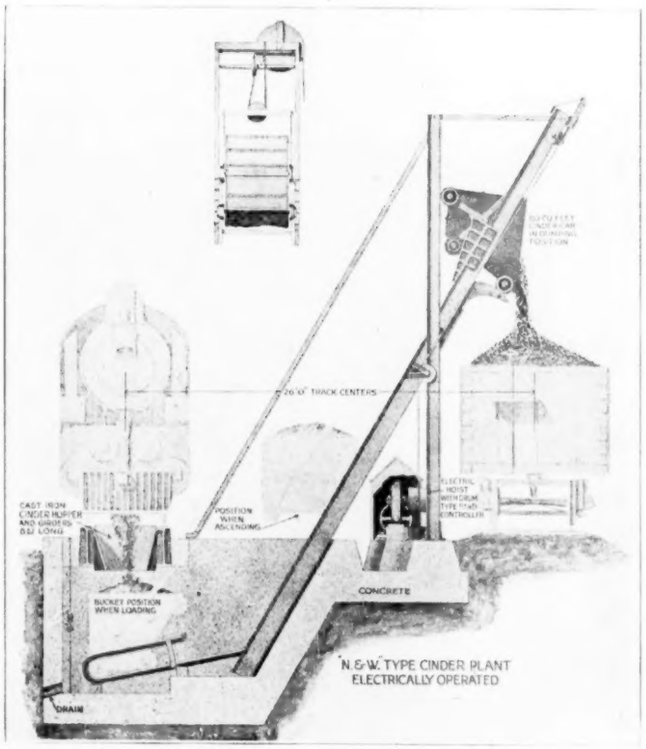
THE LOCOMOTIVE CRANE COMPANY, Champaign, Ill., has recently made several improvements in its Model A Little Giant Crane. This crane is a ground machine, mounted on flat-faced wheels, 36 in. in diameter and 14 in. wide. On these wheels the crane is capable of traveling under its own power about 2 miles per hour and of turning in a 100-ft. circle. Both wheel gage and base are 10 ft., the boom 30 ft., the capacity of the clam

Model A Little Giant Crane Handling Coal

shell bucket ¾ yd., and the approximate weight of the crane exclusive of the counter weight, 12½ tons. The crane is said to be capable of lifting 8,000 lb. with the radius of the boom at 10 ft., 6,000 lb. with the radius at 15 ft., 5,000 lb. with the radius at 20 ft., and 4,000 lb. with the radius at 25 ft. The most important feature of the new model is the double cylinder, throttle reversing swinging engine, which is self contained, and is bolted to the frame in such as way as to permit its removal without dismantling. This engine is said to operate smoothly and to facilitate adequate rapidity in the crane's movements. Other features mentioned about the crane are the use of gears made of high grade steel and the absence of frictions, slip rings, and similar articles commonly used to overcome shock and strain on the swinging mechanism in the lack of flexibility in the steam engine's operation or proper gear reductions. It is also stated that the boom-hoisting mechanism is fitted with an adjustable cone maple block friction which is controlled from the operator's stand, and that the counter weight is made of heavy plate, cut to size for bolting to the frame.

A Practical Electric Cinder Conveyor

COINCIDENT WITH ITS PORTABLE combination locomotive coaling and cinder handling plant, described in the columns of the *Daily Railway Age* of yesterday, the Roberts & Schaefer Company, Chicago, is introducing a new type of cinder plant for the use of railroads. This



New Type RandS Cinder Plant

plant is the product of several years of experimenting on the Norfolk & Western and the Nashville, Chattanooga & St. Louis, where installations of the plant as perfected are said to be operating very successfully.

In this plant, as shown in the illustration, ashes are dumped directly from the locomotive ash pans into a train bucket or cinder car located in the depressed pit below the track, this car, when filled, being hoisted up a structural steel incline to a point above an adjacent railway track and there automatically emptied of its contents. The distance required between the two tracks is 26 ft. The plant is operated electrically by means of a direct-connected hoist, by reason of which it is not subject to trouble from freezing in cold weather, and it involves no

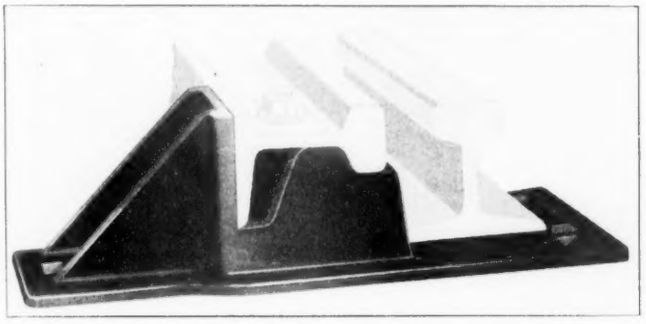
hand labor other than that required in operating the hoist. A heavy cast iron cinder hopper 8 ft. long is bolted to the track girders between the pit walls, providing the means of deflecting into the cinder car all ashes dropping from the ash pans. The cinder car itself has a capacity of 80 cu. ft. and travels at a speed of 150 ft. per min.

At many points a single installation of this type of plant is sufficient for all cinder handling requirements but where the conditions require it combinations of several such plants in various arrangements can readily be installed.

A Girder Type Guard Rail

A NUMBER OF RAILROADS are now testing out a girder type of guard rail manufactured by the Positive Rail Anchor Company, Marion, Ind. This device consists of a section of stock rail bent through its depth and bolted in the sidewise position to the supporting guard rail braces and plates, each rail brace and plate being a one-piece malleable iron unit.

It is claimed for this type of guard rail that it is impos-



Sectional View of Girder Type Guard Rail

sible for it to overturn under traffic inasmuch as the plates to which the rail is bolted are held in place by the weight of the traffic and that the "I" beam or strongest section of the rail is utilized to resist the thrust instead of the unsupported head, as is the case with the ordinary rail guard rail. As an additional point in favor of this type of guard rail, it is stated that an old rail, either of

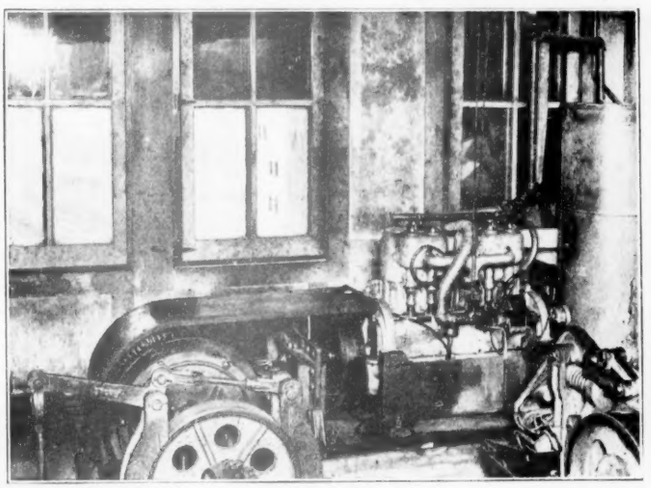
Installation of Girder Type Guard Rail

the same or of lighter section than the running rail, can be used for the guard rail, or when a road is adopting a heavier weight of rail, the old guard rail can be utilized, its preparation requiring only straightening, followed by bending through the "I" section. The fact that the rail when on its side presents a larger surface to abrasion than when upright, and that the head of the old rail, having been subject to cold rolling under traffic, is harder than a new rail are also presented in support of this device.

It is further claimed that the wide space obtaining under this type of guard rail, when installed, is a protection against clogging from snow and ice, this feature, together with the absence of parts likely to stretch or spread, and the absence of bolt connections with the running rail by means of which it might be pulled out of line by creeping movements, all contributing to reduce maintenance costs to a negligible point. Further points advanced in support of the guard rail are that the running rail can be removed without changing or disturbing the guard rail, that it can be assembled in the shop and shipped out as a one-piece guard rail, yet permitting broken parts to be replaced without scrapping the entire rail, and that a road need not alter its standards in order to employ the device inasmuch as plates may be made to fit these standards.

Recent Developments in Movable Bridge Machinery

THE PERFECTING OF THE AUTOMOBILE and marine type of high-speed gasoline engines has led to their use in operating movable bridges. Owing to their compactness and reliability, these units are particularly adapted to serve as an auxiliary to an electric installation. The Deering bridge of the Chicago & North Western over the Chicago river (built in 1916) was the first bridge on which this type of engine was installed as the auxiliary drive and since then it has practically superseded the heavy stationary type of slow-speed engines in units ranging from 18



F:g. 1. Norwood-Nocnan Installation on Illinois Central

to 95 hp. Figure 1 shows a four-cylinder 60-hp. 900-r.p.m. auxiliary gas engine installed on the Illinois Central's bascule bridge over the south branch of the Chicago river, the longest bridge of its kind built so far. On the Baltimore & Ohio's bridge at South Chicago a six-cylinder 95-hp. 1,500-r.p.m. engine is provided to drive a dynamo that supplies current for an auxiliary electric motor located on the moving span.

Figure 2 shows a 22½-hp. gas engine with clutch and reversing gears all mounted on a single base to be used as the motive power on a swing bridge where electrical current is not available. It is unique in that it is a complete unit in itself, including gasoline tank and radiator. The engine is started with a crank, larger units being started with an electric motor. The gasoline tank holds 10 gal. of fuel and the radiator is large enough to permit of the engine being run for 30 min. under full load. The spark and gas levers are mounted on a stand located on

the operating floor near the brake and clutch levers. To open the bridge the operator releases the disc friction clutch, adjusts the spark and gas levers and cranks the engine. He then returns to the operating floor and throws the jaw clutch to "open." The end lift clutch on the next shaft reduction from the engine unit is then engaged and when the ends have been lowered this clutch is released

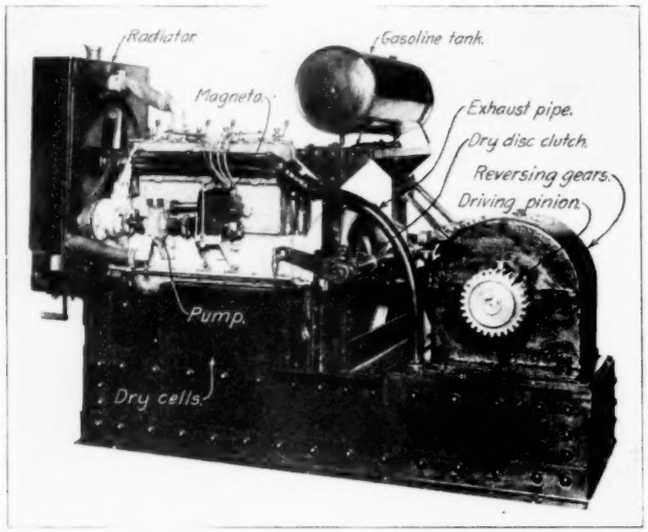


Fig. 2. A 22½ H. P. Norwood-Noonan Engine

and the swing clutch is engaged and the bridge opened. To close the bridge the cycle is reversed. This unit is to be installed on a draw span over the St. Joe river near Shatcolet, Idaho, for the Oregon-Washington Railroad & Navigation Company and was designed and built by the Norwood-Noonan Company of Chicago.

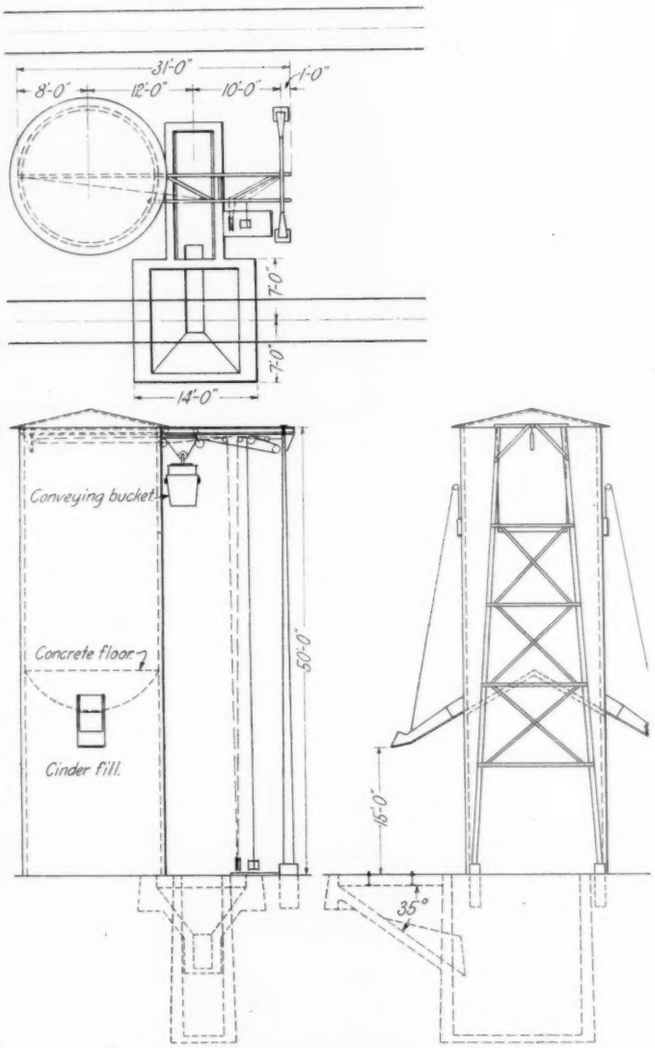
A New Type of Coal Handling Equipment

As a result of experiments and investigations conducted during the last 18 months the Godfrey Conveyor Company, Elkhart, Ind., has introduced a type of coal handling equipment for locomotive coaling service, which comprises one or more coal pockets with locomotive coaling chutes erected alongside the coaling track and arranged to accommodate the operation of a special coal-handling bucket, this bucket being filled in a pit below the track, then hoisted to a point above the coal pocket, after which it is shifted along an overhead rail to the proper dumping position, lowered and then emptied. This system is adapted for use where the amount of coal to be handled ranges from 10 tons to 4 or 5 cars per day. It is stated that the Godfrey system requires the labor of but one or two men for a period of one to three hours in unloading a car of coal, and is reported that in many instances coal is being unloaded into hoppers at a labor and power cost of 5 or 6 cents per ton by means of these systems.

The system is obviously one which allows a large flexibility in arrangement and design, permitting the hopper to be built large enough to store several cars, as at points where a reserve supply should be provided during periods of free coal movement to warrant the presence of an adequate supply during periods of shortage, also readily adapting itself to the serving of any type of hopper. Furthermore, the conveyor can be installed to run parallel to the siding, or at right angles or other angles to it, and curves can be inserted in the conveyor track where necessary.

A further advantage claimed for the Godfrey system lies in its ability to dump the coal at more than one point, and, inasmuch as the conveyor bucket, when once over the coal pocket, is lowered before emptying, to deposit the coal without fall or chuting, thus by permitting uniform mixing of lumps and dust and reducing breakage to a low point, insuring the maintenance of the coal in the best condition for locomotive use.

The silo coal pocket and wooden pocket coaling stations shown in the illustrations are served equally well by the Godfrey conveyor. In either case it is possible to prolong the conveyor structure to serve more bins or to give open storage in connection with the hopper. The merit in the latter method lies in the possibility of providing a good-sized storage with a medium-sized conveyor



Godfrey Coaling System—Silo Coal Pocket Plan

and a small hopper at points where the daily consumption is low and coal shipment irregular. In the construction of these systems the Godfrey Company recommends a pit large enough only to catch the drop from one coal car hopper, inasmuch as the time and labor consumed at small stations in pinching the car is a small item. It also calls attention to the advisability of reducing the pitch of the hopper floor to a minimum as a means of reducing first cost, although the size and angle of the track hopper is optional.